Project Final Report

Lake Gardner & Powow River Nonpoint Source Improvement Project
14-05/319

2014-2017

City of Amesbury

Grantee Project Manager: Robert Desmarais

MassDEP Project Manager: Malcolm Harper

PREPARED FOR:

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER RESOURCES

AND

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

A. Project Snapshot

A1. Project Start Date: May 7, 2014

A2. Date Closed: June 30, 2017

A3. Basin and HUC-12 watershed locations: Merrimack, HUC ID: 010700061403

A4. Segment and waterbody information:

1) Powow River (MA84A-25)
2) Lake Gardner

A5. Status of waterbody:

1) Category 5

A6. Priority pollutants targeted:

Turbidity
Total Suspended Solids
Bacteria

A7. Estimated annual pollutant removal, method of determination, and calculations with grant estimates from the application in brackets:

Sediment:	11,297 lbs. (8,300 lbs.)
Phosphorus:	9.9 lbs. (8.0 lbs.)
Nitrogen:	45.1 lbs. (35 lbs.)
Fecal Coliform	839 billion colonies (690 billion colonies)

Modeling- The Simple Method was used to calculate pollutant removal percentages for each BMP based on standard (published). Project modeled pollutant removal calculations can be found at the end of this report.

A8. BMPs installed, number and type:

- 1 infiltration basin, 2 sediment forebays, 1 outlet control structure, 2 stone check dams, 1 stone infiltration trench (300 linear feet)
- 14 deep sump catch basins with perforated pipes in infiltration trenches (1,265 linear feet)
- 5 deep sump catch basins with off-line infiltration structures
- 1 sediment forebay, 1 terraced drainage swale, 2 check dams and 1 outlet structure
- 1 deep sump catch basin with 1 off-line infiltration trench (20 linear feet)

B. Descriptive Project Summary

Descriptive Project Summary

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

SECTION 319 NPS PROJECT 14-05/319

PROJECT TITLE: Lake Gardner & Powow River Nonpoint Source Improvement Project
CATEGORY: Implementation
INVESTIGATOR: City of Amesbury
LOCATION: Amesbury, MA
TARGETED POLLUTANTS: Turbidity, Total Suspended Solids, Bacteria
Description:
Lake Gardner is a 93-acre lake that lies between several reaches of the Powow River in the Merrimack River Watershed. The Powow River is a Class A waterbody and is listed as a Category 5 impaired waterbody on the 2010 303(d) list of impaired waters for pathogens (fecal coliform), total suspended solids and turbidity. The proposed grant project will implement prioritized BMPs to reduce pathogens, total suspended solids and nutrients within the Lake Gardner and Powow River Watersheds.

Project Goals:
The goal of the proposed project was to improve the water quality of Lake Gardner and the Powow River through the implementation of both structural and non-structural BMPs. This project included:

- The design, permitting and construction of infiltration based Low Impact Development stormwater BMPs at five prioritized locations within the watershed to help decrease the input of pathogens/bacteria, sediment and nutrients into Lake Gardner/Powow River and ultimately improve the water quality of the Merrimack River.
- Implementing several non-structural BMPs including additional public education material on the importance of vegetated buffers and picking up pet waste. The installation of additional pet waste bag dispensers will also assist with pathogen reduction efforts.

Targeted Pollutants and Waterbodies:
The primary targeted pollutants included turbidity, total suspended solids and bacteria. The waterbodies of concern were Lake Gardner, Powow River and the Merrimack River.

Methods Employed/Projects Tasks:

- Stormwater BMP design and construction in the City of Amesbury – Lake Gardner/Powow River Watershed.
- Participation in North Shore Greenscapes Program.
- Creation of project specific brochure and development of education/outreach display at DPW.
- Installation of pet waste bag/disposal stations.

PROJECT COST: $278,360 (Total with actual match = $339,095.63)
FUNDING $166,960.00 (EPA)
$111,400.00 (GRANTEE) Actual Match Provided $172,135.63 (51%)
PROJECT COMPLETE: 2017
DURATION: 2014-2017

C. Project Finances

Budget: See table below.
Total Project Cost = $278,360
s.319 Grant Funds = $166,960
Non-Federal Match = ($111,400 committed) $172,135.63 actual

Original Project Budget

Expense Item	319 Amount	Non-Federal Match	Total
Salaries			
DPW Director ($55-65/hour)	$0	$2,420	$2,420
Town Engineer ($50-60/hour)	$0	$4,400	$4,400
Crew Chief ($45-55/hour)	$0	$13,680	$13,680
Operator ($40-50/hour)	$0	$12,160	$12,160
Laborer ($30-40/hour)	$0	$9,360	$9,360
Clerical ($35-45/hour)	$0	$980	$980
Subtotal Salaries	**$0**	**$43,000**	**$43,000**
Subcontractual			
CEI - Consultant Engineer (D/WBE)	$59,740	$0	$59,740
North Shore GreenScapes Program (2014-2015)	$4,000	$0	$4,000
Subtotal Subcontractual	**$63,740**	**$0**	**$63,740**
BMP Materials and Supplies			
Public education materials and printing	$1,500	$0	$1,500
Amesbury DPW Equipment Use	$0	$68,400	$68,400
BMP materials/supplies (potential D/MBE)	$99,920	$0	$99,920
Pet waste bag dispensers/supplies	$1,800	$0	$1,800
Subtotal Materials and Supplies	**$103,220**	**$68,400**	**$171,620**
Travel (.40/mile)	$0	$0	$0
Totals	**166,960**	**$111,400**	**$278,360**
Percent	60%	40 %	100%

Amended Project Budget

Expense Item	319 Amount	Amendment	Non-Federal Match	Amended Match	Total
Salaries					
DPW Director ($55-65/hour)			$2,420	$7,620	$7,620
Town Engineer ($50-60/hour)			$4,400	$10,560	$10,560
Crew Chief ($45-55/hour)			$13,680		
Operator ($40-50/hour)			$12,160		
Laborer ($30-40/hour)			$9,360		
Clerical ($35-45/hour)			$980	$2,400	$2,400
Subtotal Salaries			**$43,000**	**$20,580**	**$20,580**
Subcontractual					
CEI - Consultant Engineer (D/WBE)					
	$59,740	$59,740			$59,740
North Shore GreenScapes Program (2014-2015)					
	$4,000	$3,600			$3,600
Subtotal Subcontractual	**$63,740**	**$63,340**			**$63,340**
BMP Materials and Supplies					
Public education materials and printing					
	$1,500	$1,629.74			$1,629.74
Amesbury Paid Construction Match			$68,400	$151,555.63	$151,555.63
BMP materials/supplies (potential D/MBE)					
	$99,920	$100,202.38			$100,202.38
Pet waste bag dispensers/supplies					
	$1,800	$1,787.88			$1,787.38
Subtotal Materials and Supplies					
	$103,220	**$103,620**	**$68,400**	**$151,555.63**	**$255,175.63**
Totals	**$166,960**	**$166,960**	**$111,400**	**$172,135.63**	**$339,095.63**
Percent	60%	49%	40 %	51%	100%

All tasks were completed within the original project final budget.

Match Documentation: Project match was met by in-kind and paid services provided by the City of Amesbury.

Match Requirement = $111,400 Actual Match Provided = $172,135.63

D. BMPs

Site #1. Whitehall Road 1

D1. Type of BMP: 1 infiltration basin, 2 sediment forebays, 1 outlet control structure, 2 stone check dams, 1 stone infiltration trench (300 linear feet)

D2. Date of implementation: June 30, 2016

D3. Size of treatment area: 26.3 ac

D4. Pollutant load removal:
TSS: 1,137 lbs.
P: 0.88 lbs.
N: 3.14 lbs.
Fecal Coliform: 68 billion colonies

D5. Method of determination and calculations:
Modeling- The Simple Method was used to calculate pollutant removal percentages for each BMP based on standard (published) rates. See attached pollutant removal statement.

Site #2. Whitehall Road 2

D1. Type of BMP: 14 deep sump catch basins with perforated pipes in infiltration trenches (1,265 linear feet).

D2. Date of implementation: Spring 2017

D3. Size of treatment area: 25.3 ac

D4. Pollutant load removal:
TSS: 5,471 lbs.
P: 4.5 lbs.
N: 19.4 lbs.
Fecal Coliform: 397 billion colonies

D5. Method of determination and calculations:
Modeling- The Simple Method was used to calculate pollutant removal percentages for each BMP based on standard (published) rates. See attached pollutant removal statement.

Site #3. Whitehall Road 3

D1. Type of BMP: 5 deep sump catch basins and off-line infiltration structures

D2. Date of implementation: June 30, 2017

D3. Size of treatment area: 3.5 ac

D4. Pollutant load removal:
TSS: 3,576 lbs.
P: 2.74 lbs.
N: 12.53 lbs.
Fecal Coliform: 307 billion colonies

D5. Method of determination and calculations:
Modeling- The Simple Method was used to calculate pollutant removal percentages for each BMP based on standard (published) rates. See attached pollutant removal statement.

Site #4 Cynthia Road

D1. Type of BMP: 1 sediment forebay, 1 terraced drainage swale, 2 check dams and 1 outlet structure

D2. Date of implementation: June 30, 2017

D3. Size of treatment area: 3.75 ac

D4. Pollutant load removal:

TSS: 793 lbs.
P: 1.52 lbs.
N: 8.83 lbs.
Fecal Coliform: 33 billion colonies

D5. Method of determination and calculations:
Modeling- The Simple Method was used to calculate pollutant removal percentages for each BMP based on standard (published) rates. See attached pollutant removal statement.

Site #5 Orchard Court

D1. Type of BMP: 1 deep sump catch basin with 1 off-line infiltration trench (20 linear feet)
D2. Date of implementation: June 30, 2017
D3. Size of treatment area: 0.4 ac
D4. Pollutant load removal:
TSS: 320 lbs.
P: 0.3 lbs.
N: 1.2 lbs.
Fecal Coliform: 34 billion colonies

D5. Method of determination and calculations:
Modeling- The Simple Method was used to calculate pollutant removal percentages for each BMP based on standard (published) rates. See attached pollutant removal statement.

E. Lesson Learned

The Whitehall Road 3 location was substituted for the original Lake Gardner Beach erosion BMP site due to permitting issues. The Amesbury DPW was flexible and capable of shifting construction efforts quickly to accommodate a new location and new set of BMPs. The DPW committed to proceeding with the Lake Gardner Beach erosion BMP outside of grant funding/timing in an effort to work through permitting and complete the BMP construction.

F. Appendix/Attachments

Task 1 Deliverables - Quality Assurance and Project Evaluation

1a. Modeled results of anticipated pollutant load reductions achieved by BMPs implemented under this project, produced by the project designer, engineer, or other qualified person.

See Section D of this report and attached model results.

1b. Documentation of the BMP implementation work. Information to be supplied for each BMP includes BMP type, date of completed installation, targeted pollutant(s), size of targeted treatment area, and site maps.

See Section D of this report and attached site map.

Task 2 Deliverables - Design and Construct Stormwater Management BMPs

2a. Final design and construction plans for the BMPs as described, submitted for review and comment to the MassDEP project officer prior to construction. Final plans must be reviewed and stamped by a professional engineer prior to review by the MassDEP project officer.

Final plans attached.

2b. Construction permits and approvals.

None needed.

2c. Final "as-built" drawings of the completed BMPs.

Stamped 'as-built' drawings attached.

2d. Certificate/letter from the designer or supplier stating the BMPs have been installed according to design specifications.

Letter of completion attached.

2e. Installed BMPs.

See attached as-built plans (Deliverable 2c) and BMP location map (Deliverable 1b).

2f. Digital format pre- and post-photodocumentation of site, construction, and completed BMPs.

BMP photographs attached.

Task 3 Deliverables - BMP Operation and Maintenance Plan

3a. A long-term operation and maintenance plan for the BMPs installed in Task 2.

City of Amesbury O&M Plan attached.

3b. A technical memo outlining operation and maintenance activities that have commenced since completion of BMP implementation.

Only visual inspections have taken place to date.

Task 4 Deliverables – Pet Waste Management

4a. Location of 5 pet waste bag dispensing units.

Location map of units and photographs of typical installation.

Task 5. Deliverables – Public Education and Outreach

5a. Photo of stormwater displays.

Photographs attached.

5b. List/copies of material made available and website links.

List of materials/website links include:

- *After the Storm: A Citizen's Guide to Understanding Stormwater, U.S. EPA, January 2003*
- *Prevent the Spread of Invasive Species, MA DCR, 2008*
- *Household Stormwater Pollution Prevention, MA DCR, March 2011*
- *Dog Waste & Surface Water Quality, MA DCR, March 2015*
- *Phosphorus in Fertilizers, MA DCR, November 2015*
- *Clean Water is Everyone's Business Bookmark, U.S. EPA*
- *Going Green with Storm Water – Rain Gardens, Mass Audubon*
- *Make Your Home the Solution to Stormwater Pollution, U.S. EPA, January 2003*
- *Composting is Easy, MassDEP*
- Protecting Water Sources from Fertilizer, Bureau of Farm Products and Plant Industries
- Give Your Lake the Blues: Protecting Your Lake from Nonpoint Source Pollution, MassDEP
- Healthy Lawns – Healthy Water, MA DAR
- UMass Soil Test Order Form & Instructions
- Protecting Water Quality from Agricultural Runoff, U.S. EPA 841-F-05-001, 2005
- Protecting Water Quality from Urban Runoff, U.S. EPA 841-F-03-003, 2003
- Discover Storm Water, Project WET, April 2016
- Watershed Protection, Project WET, March 2015

5c. Project specific brochure.

Project specific brochure attached.

Task 6 Deliverables - Greenscapes

6a. List of materials made available to watershed residents as part of this program.

2014:

- Keeping Water Clean School Program
- Stormwater Brochure - 500
- "Greenscapes 101" Presentation
- Media Relations
- Greenscapes Web Site
- Guide to Greenscaping - 100

- E-mail Newsletter
- 500 Pet Waste informational rack cards
- 2 Stormwater Public Service Announcements

2015:

- *Keeping Water Clean School Program*
- *Stormwater Rack Cards – 500 copies*
- *Greenscapes 101 Presentation*
- *Greenscapes Web Site*
- *Guide to Greenscaping – 100 copies*
- *E-mail Newsletter*

6b. List of activities and number of participants as part of this program

See above.

Task 7 Deliverables - Reporting and Project Oversight

7a. Quarterly progress reports.

All quarterly progress reports have been submitted to MassDEP.

7b. Quarterly filing of forms.

All quarterly forms have been filed with MassDEP.

7c. Draft final report.

The project draft final report has been submitted for review.

7d. Three (3) complete hard copies of the final report and two CDs with electronic versions of the final report.

Hard and electronic copies of the final report have been submitted to MassDEP.

Appendices

Task 1 Deliverables

Lake Gardner s319 Grant Project 2017
Amesbury, MA

The Simple Method - Pollutant Reduction Model

Whitehall Road - Treatment Train Pollutant Loading Estimates

No.	Watershed Name	Landuse ID	Landuse	Area (acres)	Sanded?	Sanded Area (acres)	% Impervious	Runoff (in)	Pretreatment (0.1"/ Imp. acre) cf	Treatment (1"/ Imp. acre) cf	Annual Runoff (cf)	Annual TSS (lbs)	Annual TP (lbs)	Annual TN (lbs)	Annual FC (billion colonies)
1	Whitehall 1 - Woods	2	Forested	13.500	No	0.000	5	3.8	245.0	2,450	188,547	1,326	4.11	12.9	16.0
1	Whitehall 1 - Residential	4	Multifamily	4.100	Yes	1.230	60	23.9	893.0	8,930	355,629	7,700	8.86	48.7	706.4
1	Whitehall 1 - Pasture	10	Pasture	8.700	No	0.000	5	3.8	157.9	1,579	121,508	530	0.91	10.6	10.3
2	Whitehall 2 - Woods	2	Forested	10.900	No	0.000	5	3.8	197.8	1,978	152,234	1,071	3.32	10.4	13.0
2	Whitehall 2 - Residential	7	Residential-Med. Density	12.800	Yes	1.920	30	13.0	1,393.9	13,939	602,173	12,787	15.00	82.5	1,196.1
2	Whitehall 2 - Roadway	9	Roadway/Parking Lot	1.600	Yes	1.152	80	31.2	464.6	4,646	181,122	6,234	5.64	33.8	87.4
				0.000		0.000	0	0.0	0.0	0	0	0	0.00	0.0	0.0
Total				51.600		4.302			**3,352**	**33,523**	**1,601,214**	**29,647**	**38**	**199**	**2,029**

Landuse[1]	Landuse ID (used for v-lookup)	% Impervious	(C) TSS (mg/l)	(C) TP (mg/l)	(C) TN (mg/l)	*Fecal Coliform (colonies/100 mL)	Landuse
Commercial	1	85	75	0.2	2	4600	Commercial
Forested	2	5	113	0.35	1.1	300	Forested
Open Urban Land	3	9	48.5	0.31	0.74	300	Open Urban Land
Multifamily	4	60	100	0.4	2.2	7000	Multifamily
Residential-High Density	5	40	100	0.4	2.2	7000	Residential-High Density
Residential-Low Density	6	10	100	0.4	2.2	7000	Residential-Low Density
Residential-Med. Density	7	30	100	0.4	2.2	7000	Residential-Med. Density
Industrial~	8	75	149	0.32	3.97	2400	Industrial
Roadway/Parking Lot	9	80	150	0.5	3	1700	Roadway/Parking Lot
Pasture	10	5	70	0.12	1.4	300	Pasture

[1] High density residential (<1/4 acre lots); Medium density residential (1/4 to 1/2 acre lots); Low density residential (>1 acre lots); Multifamily (>7 dwellings per acre).

Sanded Area -

If Yes, copy and paste the corresponding equation into sanded area cell:

0.000	Equation for Residential, Commercial & Parking Lot
0.000	Equation for Industrial
0.000	Equation for Roadways & Highways

Annual Rainfall	45	inches; user specified
P_j	0.9	%; default
Sanding Rate	500	lbs/acre; default
Sanding Applications	10	times/year; default

References:

Massachusetts Department of Environmental Protection Stormwater Manual, Volume 1 - Chapter 1 – Water Quality Volumes, February 2008. Retrieved on July 14, 2010 from the World Wide Web: http://www.mass.gov/dep/water/laws/policies.htm#storm

Pitt, Robert. (2004, February 16). The National Stormwater Quality Database (NSQD, version 1.1). Retrieved July 22, 2005 from the World Wide Web: http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/recentpaper.htm

The New York Stormwater Management Design Manual Appendix A. Retrieved July 22, 2005 from the World Wide Web: http://www.dec.state.ny.us/website/dow/toolbox/simple.pdf

The Simple Method to Calculate Urban Stormwater Loads. Retrieved July 22, 2005 from the World Wide Web: http://www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm

~Appendix D, Volume 1 of the New Hampshire Stormwater Manual, December 2008

Pollutant Loading Formulas (Simple Method Equations):

TSS, TP, TN

$L = 0.226 * R * C * A$

Where:

L = Annual Load (lbs)
R = Annual Runoff (inches)
C = Pollutant Concentration (mg/l)
A = Area (acres)
0.226 = Unit Conversion Factor

Fecal Coliform

$L = .00103 * R * C * A$

Where:

L = Annual Load (Billion Colonies)
R = Annual Runoff (inches)
C = Pollutant Concentration (#col/100mL)
A = Area (acres)
0.00103 = Unit Conversion Factor

$R = P * P_j * Rv$

Where:

R = Annual Runoff (inches)
P = Annual Rainfall (inches)
P_j = % of rainfall events producing runoff
Rv = Runoff Coefficient = 0.05+0.9 * Ia
Ia = Impervious Fraction (%)

Notes:

1. Sanding applications assume 50% of residential, parking lots and commercial impervious areas are sanded while 66% (2/3) of the impervious area of industrial properties is sanded.
2. Assume sanding application for roadways is 90% of the total roadway area.
3. Annual rainfall based on historical data from Weather Underground on the World Wide Web: http://www.wunderground.com/

Remarks / Comments:

Model watershed information and BMP sizing based on attached CAD plans & ortho imagery. Annual precipitation from Weather Underground Website for Lawerence, MA weather station METAR KLWM 01135 00000KT 10SM CLR 06/01 A3040 RMK AO2 SLP295 T00560011. Precipitation based on the average annual rainfall over a five year period ranging from years 2006 to 2011 for that weather station.

Model Entered By: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Reviewed by: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Evaluated by: _____ Date: _____ Signature: _____ Date Accepted: _____

Lake Gardner s319 Grant Project 2017
Amesbury, MA

The Simple Method - Pollutant Reduction Model

Whitehall Road - Treatment Train Pollutant Loading Estimates Pollutant Reduction Estimates

No.	Watershed Name	BMP ID	BMP Type	BMP Drainage Area (acres)	BMP Removal Efficiency^ TSS Removal (%)	TP Removal (%)	TN Removal (%)	Fecal Coliform Removal**(%)	Quantity of Pollutant Removed: Annual TSS Removed (lbs)	Annual TP Removed (lbs)	Annual TN Removed (lbs)	Annual Fecal Coliform Removed (billion colonies)	Pretreatment / Treatment
1st BMP in series													
1	Whitehall 1 Discharging to Swale	2	Forebay**	26.300	7.1%	2.3%	0.9%	3.4%	682	0.32	0.62	25	Pretreatment
2	Whitehall 2 Discharging to CB and Perforated Pipe	4	Leaching Catch Basin	25.300	27.2%	18.7%	15.3%	30.6%	5,471	4.48	19.41	397	Pretreatment
2nd BMP in series													
1	Whitehall 1 Discharging to Infiltration Basin	8	Infiltration Basin	26.300	5.1%	4.2%	3.5%	6.1%	455	0.56	2.52	43	Treatment
2	Whitehall 2 Discharging to CB and Perforated Pipe	8	Infiltration Pipe/Trench	0.000	#VALUE!	#VALUE!	#VALUE!	90.0%	0	0.00	0.00	0	Treatment
	TOTAL REMOVAL =								**6,608**	**5.4**	**22.6**	**465**	
	% REMOVAL =								**22.3%**	**14.2%**	**11.3%**	**22.9%**	

Note: The removal efficiencies shown for all BMPs in series after the first BMP have been adjusted to account for the reduced efficiency (e.g., 50% or 75%) as explained in "Pollutant Removal of BMPs in Series Equation"

BMP Type	BMP ID (used for v-lookup)	TSS Removal (%)	TP Removal (%)	TN Removal (%)	Fecal Coliform Removal** (%)	Pretreatment / Treatment	BMP Type
Vegetated Swale	1	70%	55%	50%	60%	Pretreatment	Vegetated Swale
Forebay**	2	25%	8%	3%	12%	Pretreatment	Forebay**
Deep Sump Catch Basin**	3	25%	8%	3%	12%	Pretreatment	Deep Sump Catch Basin**
Leaching Catch Basin	4	80%	55%	45%	90%	Pretreatment	Leaching Catch Basin
Wet Pond	5	80%	50%	30%	70%	Treatment	Wet Pond
Permeable Pavers	6	80%	60%	40%	95%	Treatment	Permeable Pavers
Raingarden	7	90%	60%	40%	70%	Treatment	Raingarden
Infiltration Basin	8	80%	65%	55%	95%	Treatment	Infiltration Basin
Infiltration Chambers**	9	80%	55%	40%	90%	Treatment	Infiltration Chambers**
Sand Organic Filters**	10	80%	30%	30%	90%	Treatment	Sand Organic Filters**
Gravel Wetland***	11	95%	64%	85%	85%	Treatment	Gravel Wetland***
Extended Dry Detention Basin	12	50%	20%	35%	60%	Treatment	Extended Dry Detention Basin
Constructed Wetlands	13	80%	50%	35%	60%	Treatment	Constructed Wetlands

EXAMPLE:
Pollutant Removal of BMPs in Series Equation:
If removal from the 1st BMP is >80%, the 2nd BMP efficiency shall be 50% of its normal efficiency.
If removal from the 1st BMP is <80%, the 2nd BMP efficiency shall be 75% of its normal efficiency.
Example: TSS load of 100lbs. 1st BMP removal 85%, 2nd BMP removal 40%.
TSS Removal = 100lbs * 85% = 85 lbs in 1st BMP
TSS Removal = (100lb-85lb) * (40% * .5) = 3 lbs in 2nd BMP
Net TSS Removal = 88 lbs

References:

Comparative Pollutant Removal Capability of Stormwater Treatment Practices, Technical Note #95 from Watershed Protection Techniques. 2(4): 515-520, Article 64. Retrieved July 22, 2005 from the World Wide Web: http://www.stormwatercenter.net/Practice/64-Comparative%20Pollutant%20Removal.pdf
Choi, J & Engel, B. Urban BMPs and Cost Estimation, Structural BMP Expected Pollutant Removal Efficiency & Median Event Mean Concentration for Urban Land Uses. US EPA. (1993) Handbook Urban Runoff Pollution and Control Planning. Retrieved July 22, 2005 from the World Wide Web: http://danpatch.ecn.purdue.edu/~jychoi/ubmp0/emc2.htm
Massachusetts Nonpoint Source Pollution Management Manual. Retrieved October 19, 2006 from the World Wide Web. Web: http://projects.geosyntec.com/NPSManual/
Pennsylvania Stormwater Best Management Practices Manual, Chapter 6 - Structural BMPs. Retrieved October 18, 2006 from the World Wide Web. Web: http://www.starkenvironmental.com/downloads/PADEP.pdf
Rhode Island Stormwater Design and Installation Standards Manual Appendix H, December 2010
^Volume 2, Chapter 2 of the 2008 Massachusetts Storm Water Manual
*Table H-2 of the 2010 Rhode Island Storm Water Manual
**Table H-3 & H-4 of the 2010 Rhode Island Storm Water Manual
***Appendix E, Volume 1 of the New Hampshire Stormwater Manual, December 2008

Remarks / Comments:
BMP Volume for infiltration area assumes a 30% porosity in crushed stone. Model Calibration has not been completed to date

Model Entered By: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Reviewed by: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Evaluated by: _____ Date: _____ Signature: _____ Date Accepted: _____

Lake Gardner s319 Grant Project 2017
Amesbury, MA

The Simple Method - Pollutant Reduction Model

Whitehall Road and Cynthia Road - Treatment Train Pollutant Loading Estimates

No.	Watershed Name	Landuse ID	Landuse	Area (acres)	Sanded?	Sanded Area (acres)	% Impervious	Runoff (in)	Pretreatment (0.1"/ Imp. acre) cf	Treatment (1"/ Imp. acre) cf	Annual Runoff (cf)	Annual TSS (lbs)	Annual TP (lbs)	Annual TN (lbs)	Annual FC (billion colonies)
1	Whitehall/Cynthia Road Treatment Train	7	Residential-Med. Density	3.500	Yes	0.525	30	13.0	381.2	3,812	164,657	3,496	4.10	22.6	327.0
1	Whitehall/Cynthia Road Treatment Train	9	Roadway/Parking Lot	0.250	Yes	0.180	80	31.2	72.6	726	28,300	974	0.88	5.3	13.7
Total				3.750		0.525			**454**	**4,538**	**192,957**	**4,470**	**4.98**	**27.8**	**340.7**

Landuse[1]	Landuse ID (used for v-lookup)	% Impervious	(C) TSS (mg/l)	(C) TP (mg/l)	(C) TN (mg/l)	*Fecal Coliform (colonies/100 mL)	Landuse
Commercial	1	85	75	0.2	2	4600	Commercial
Forested	2	5	113	0.35	1.1	300	Forested
Open Urban Land	3	9	48.5	0.31	0.74	300	Open Urban Land
Multifamily	4	60	100	0.4	2.2	7000	Multifamily
Residential-High Density	5	40	100	0.4	2.2	7000	Residential-High Density
Residential-Low Density	6	10	100	0.4	2.2	7000	Residential-Low Density
Residential-Med. Density	7	30	100	0.4	2.2	7000	Residential-Med. Density
Industrial~	8	75	149	0.32	3.97	2400	Industrial
Roadway/Parking Lot	9	80	150	0.5	3	1700	Roadway/Parking Lot
Pasture	10	5	70	0.12	1.4	300	Pasture

[1] High density residential (<1/4 acre lots); Medium density residential (1/4 to 1/2 acre lots); Low density residential (>1 acre lots); Multifamily (>7 dwellings per acre).

Sanded Area -

If Yes, copy and paste the corresponding equation into sanded area cell:

0.000	Equation for Residential, Commercial & Parking Lot
0.000	Equation for Industrial
0.000	Equation for Roadways & Highways

Annual Rainfall	45	inches; user specified
P_j	0.9	%; default
Sanding Rate	500	lbs/acre; default
Sanding Applications	10	times/year; default

References:
Massachusetts Department of Environmental Protection Stormwater Manual, Volume 1 - Chapter 1 – Water Quality Volumes, February 2008. Retrieved on July 14, 2010 from the World Wide Web: http://www.mass.gov/dep/water/laws/policies.htm#storm
Pitt, Robert. (2004, February 16). The National Stormwater Quality Database (NSQD, version 1.1). Retrieved July 22, 2005 from the World Wide Web: http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/recentpaper.htm
The New York Stormwater Management Design Manual Appendix A. Retrieved July 22, 2005 from the World Wide Web: http://www.dec.state.ny.us/website/dow/toolbox/simple.pdf
The Simple Method to Calculate Urban Stormwater Loads. Retrieved July 22, 2005 from the World Wide Web: http://www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm
~Appendix D, Volume 1 of the New Hampshire Stormwater Manual, December 2008

Pollutant Loading Formulas (Simple Method Equations):

TSS, TP, TN

$L = 0.226 * R * C * A$

Where:
- L = Annual Load (lbs)
- R = Annual Runoff (inches)
- C = Pollutant Concentration (mg/l)
- A = Area (acres)
- 0.226 = Unit Conversion Factor

Fecal Coliform

$L = .00103 * R * C * A$

Where:
- L = Annual Load (Billion Colonies)
- R = Annual Runoff (inches)
- C = Pollutant Concentration (#col/100mL)
- A = Area (acres)
- 0.00103 = Unit Conversion Factor

$R = P * P_j * Rv$

Where:
- R = Annual Runoff (inches)
- P = Annual Rainfall (inches)
- P_j = % of rainfall events producing runoff
- Rv = Runoff Coefficient = 0.05+0.9 * Ia
- Ia = Impervious Fraction (%)

Notes:
1. Sanding applications assume 50% of residential, parking lots and commercial impervious areas are sanded while 66% (2/3) of the impervious area of industrial properties is sanded.
2. Assume sanding application for roadways is 90% of the total roadway area.
3. Annual rainfall based on historical data from Weather Underground on the World Wide Web: http://www.wundergrund.com/

Remarks / Comments:
Model watershed information and BMP sizing based on attached CAD plans & ortho imagery. Annual precipitation from Weather Underground Website for Lawerence, MA weather station METAR KLWM 01135 00000KT 10SM CLR 06/01 A3040 RMK AO2 SLP295 T00560011. Precipitation based on the average annual rainfall over a five year period ranging from years 2006 to 2011 for that weather station.

Model Entered By: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Reviewed by: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Evaluated by: _____ Date: _____ Signature: _____ Date Accepted: _____

Lake Gardner s319 Grant Project 2017
Amesbury, MA

The Simple Method - Pollutant Reduction Model

Whitehall Road and Cynthia Road - Treatment Train Pollutant Loading Estimates Pollutant Reduction Estimates

					BMP Removal Efficiency^				Quantity of Pollutant Removed				
No.	Watershed Name	BMP ID	BMP Type	BMP Drainage Area (acres)	TSS Removal (%)	TP Removal (%)	TN Removal (%)	Fecal Coliform Removal**(%)	Annual TSS Removed (lbs)	Annual TP Removed (lbs)	Annual TN Removed (lbs)	Annual Fecal Coliform Removed (billion colonies)	Pretreatment / Treatment
1st BMP in series													
1	Whitehall/Cynthia Road Treatment Train	4	Leaching Catch Basin	3.750	80.0%	55.0%	45.0%	90.0%	3,576	2.74	12.53	307	Pretreatment
1	Whitehall/Cynthia Road Treatment Train	2	Forebay**	3.750	25.0%	8.0%	3.0%	12.0%	224	0.18	0.46	4	Pretreatment
2nd BMP in series													
1	Whitehall/Cynthia Road Treatment Train	8	Infiltration Basin	3.750	80.0%	65.0%	55.0%	95.0%	536	1.34	8.17	28	Treatment
1	Whitehall/Cynthia Road Treatment Train	3	Deep Sump Catch Basin**	3.750	25.0%	8.0%	3.0%	12.0%	34	0.06	0.20	0.2	Treatment
								TOTAL REMOVAL =	4,370	4.3	21.4	339	
								% REMOVAL =	97.8%	86.7%	76.7%	99.6%	

Note: The removal efficiencies shown for all BMPs in series after the first BMP have been adjusted to account for the reduced efficiency (e.g., 50% or 75%) as explained in "Pollutant Removal of BMPs in Series Equation"

BMP Type	BMP ID (used for v-lookup)	TSS Removal (%)	TP Removal (%)	TN Removal (%)	Fecal Coliform Removal** (%)	Pretreatment / Treatment	BMP Type
Vegetated Swale	1	70%	55%	50%	60%	Pretreatment	Vegetated Swale
Forebay**	2	25%	8%	3%	12%	Pretreatment	Forebay**
Deep Sump Catch Basin**	3	25%	8%	3%	12%	Pretreatment	Deep Sump Catch Basin**
Leaching Catch Basin	4	80%	55%	45%	90%	Pretreatment	Leaching Catch Basin
Wet Pond	5	80%	50%	30%	70%	Treatment	Wet Pond
Permeable Pavers	6	80%	60%	40%	95%	Treatment	Permeable Pavers
Raingarden	7	90%	60%	40%	70%	Treatment	Raingarden
Infiltration Basin	8	80%	65%	55%	95%	Treatment	Infiltration Basin
Infiltration Chambers**	9	80%	55%	40%	90%	Treatment	Infiltration Chambers**
Sand Organic Filters**	10	80%	30%	30%	90%	Treatment	Sand Organic Filters**
Gravel Wetland***	11	95%	64%	85%	85%	Treatment	Gravel Wetland***
Extended Dry Detention Basin	12	50%	20%	35%	60%	Treatment	Extended Dry Detention Basin
Constructed Wetlands	13	80%	50%	35%	60%	Treatment	Constructed Wetlands

EXAMPLE:
Pollutant Removal of BMPs in Series Equation:
If removal from the 1st BMP is >80%, the 2nd BMP efficiency shall be 50% of its normal efficiency.
If removal from the 1st BMP is <80%, the 2nd BMP efficiency shall be 75% of its normal efficiency.
Example: TSS load of 100lbs. 1st BMP removal 85%, 2nd BMP removal 40%.
TSS Removal = 100lbs * 85% = 85 lbs in 1st BMP
TSS Removal = (100lb-85lb) * (40% * .5) = 3 lbs in 2nd BMP
Net TSS Removal = 88 lbs

References:

Comparative Pollutant Removal Capability of Stormwater Treatment Practices, Technical Note #95 from Watershed Protection Techniques. 2(4): 515-520, Article 64. Retrieved July 22, 2005 from the World Wide Web: http://www.stormwatercenter.net/Practice/64-Comparative%20Pollutant%20Removal.pdf
Choi, J & Engel, B. Urban BMPs and Cost Estimation, Structural BMP Expected Pollutant Removal Efficiency & Median Event Mean Concentration for Urban Land Uses. US EPA. (1993) Handbook Urban Runoff Pollution and Control Planning. Retrieved July 22, 2005 from the World Wide Web: http://danpatch.ecn.purdue.edu/~jychoi/ubmp0/emc2.htm
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Pennsylvania Stormwater Best Management Practices Manual, Chapter 6 - Structural BMPs. Retrieved October 18, 2006 from the World Wide Web. Web: http://www.starkenvironmental.com/downloads/PADEP.pdf
Rhode Island Stormwater Design and Installation Standards Manual Appendix H, December 2010
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*Table H-2 of the 2010 Rhode Island Storm Water Manual
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***Appendix E, Volume 1 of the New Hampshire Stormwater Manual, December 2008

Remarks / Comments:
BMP Volume for infiltration area assumes a 30% porosity in crushed stone. Model Calibration has not been completed to date

Model Entered By: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Reviewed by: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Evaluated by: _____ Date: _____ Signature: _____ Date Accepted: _____

Lake Gardner s319 Grant Project 2017
Amesbury, MA

The Simple Method - Pollutant Reduction Model

Orchard Court - Deep Sump CB & Off-line Infiltration Trench Pollutant Loading Estimates

No.	Watershed Name	Landuse ID	Landuse	Area (acres)	Sanded?	Sanded Area (acres)	% Impervious	Runoff (in)	Pretreatment (0.1"/ Imp. acre) cf	Treatment (1"/ Imp. acre) cf	Annual Runoff (cf)	Annual TSS (lbs)	Annual TP (lbs)	Annual TN (lbs)	Annual FC (billion colonies)
1	Orchard Court - Residential	7	Residential-Med. Density	0.400	Yes	0.060	30	13.0	43.6	436	18,818	400	0.47	2.6	37.4
Total				0.400		0.060			**44**	**436**	**18,818**	**400**	**0.47**	**2.6**	**37.4**

Landuse[1]	Landuse ID (used for v-lookup)	% Impervious	(C) TSS (mg/l)	(C) TP (mg/l)	(C) TN (mg/l)	*Fecal Coliform (colonies/100 mL)	Landuse
Commercial	1	85	75	0.2	2	4600	Commercial
Forested	2	5	113	0.35	1.1	300	Forested
Open Urban Land	3	9	48.5	0.31	0.74	300	Open Urban Land
Multifamily	4	60	100	0.4	2.2	7000	Multifamily
Residential-High Density	5	40	100	0.4	2.2	7000	Residential-High Density
Residential-Low Density	6	10	100	0.4	2.2	7000	Residential-Low Density
Residential-Med. Density	7	30	100	0.4	2.2	7000	Residential-Med. Density
Industrial~	8	75	149	0.32	3.97	2400	Industrial
Roadway/Parking Lot	9	80	150	0.5	3	1700	Roadway/Parking Lot
Pasture	10	5	70	0.12	1.4	300	Pasture

[1] High density residential (<1/4 acre lots); Medium density residential (1/4 to 1/2 acre lots); Low density residential (>1 acre lots); Multifamily (>7 dwellings per acre).

Sanded Area -

If Yes, copy and paste the corresponding equation into sanded area cell:

0.000	Equation for Residential, Commercial & Parking Lot
0.000	Equation for Industrial
0.000	Equation for Roadways & Highways

Annual Rainfall	45	inches; user specified
P_j	0.9	%; default
Sanding Rate	500	lbs/acre; default
Sanding Applications	10	times/year; default

References:
Massachusetts Department of Environmental Protection Stormwater Manual, Volume 1 - Chapter 1 – Water Quality Volumes, February 2008. Retrieved on July 14, 2010 from the World Wide Web: http://www.mass.gov/dep/water/laws/policies.htm#storm
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~Appendix D, Volume 1 of the New Hampshire Stormwater Manual, December 2008

Pollutant Loading Formulas (Simple Method Equations):

TSS, TP, TN

$L = 0.226 * R * C * A$

Where:
- L = Annual Load (lbs)
- R = Annual Runoff (inches)
- C = Pollutant Concentration (mg/l)
- A = Area (acres)
- 0.226 = Unit Conversion Factor

Fecal Coliform

$L = .00103 * R * C * A$

Where:
- L = Annual Load (Billion Colonies)
- R = Annual Runoff (inches)
- C = Pollutant Concentration (#col/100mL)
- A = Area (acres)
- 0.00103 = Unit Conversion Factor

$R = P * P_i * Rv$

Where:
- R = Annual Runoff (inches)
- P = Annual Rainfall (inches)
- P_j = % of rainfall events producing runoff
- Rv = Runoff Coefficient = 0.05+0.9 * Ia
- Ia = Impervious Fraction (%)

Notes:
1. Sanding applications assume 50% of residential, parking lots and commercial impervious areas are sanded while 66% (2/3) of the impervious area of industrial properties is sanded.
2. Assume sanding application for roadways is 90% of the total roadway area.
3. Annual rainfall based on historical data from Weather Underground on the World Wide Web: http://www.wunderground.com/

Remarks / Comments:

Model watershed information and BMP sizing based on attached CAD plans & ortho imagery. Annual precipitation from Weather Underground Website for Lawerence, MA weather station METAR KLWM 01135 00000KT 10SM CLR 06/01 A3040 RMK AO2 SLP295 T00560011. Precipitation based on the average annual rainfall over a five year period ranging from years 2006 to 2011 for that weather station.

Model Entered By: _____ Date: _____ Signature: _____ Date Accepted: _____

Model Reviewed by: _____ Date: _____ Signature: _____ Date Accepted: _____

Model Evaluated by: _____ Date: _____ Signature: _____ Date Accepted: _____

Lake Gardner s319 Grant Project 2017
Amesbury, MA

The Simple Method - Pollutant Reduction Model

Orchard Court - Deep Sump CB & Off-line Infiltration Trench Pollutant Loading Estimates Pollutant Reduction Estimates

					BMP Removal Efficiency^				Quantity of Pollutant Removed				
No.	Watershed Name	BMP ID	BMP Type	BMP Drainage Area (acres)	TSS Removal (%)	TP Removal (%)	TN Removal (%)	Fecal Coliform Removal**(%)	Annual TSS Removed (lbs)	Annual TP Removed (lbs)	Annual TN Removed (lbs)	Annual Fecal Coliform Removed (billion colonies)	Pretreatment / Treatment
1st BMP in series													
1	Residential	4	Off-lIne Infiltration Trench	0.400	80.0%	55.0%	45.0%	90.0%	320	0.3	1.2	33.6	Pretreatment

TOTAL REMOVAL =	**320**	**0.3**	**1.2**	**34**
% REMOVAL =	**80.0%**	**55.0%**	**45.0%**	**90.0%**

Note: The removal efficiencies shown for all BMPs in series after the first BMP have been adjusted to account for the reduced efficiency (e.g., 50% or 75%) as explained in "Pollutant Removal of BMPs in Series Equation"

BMP Type	BMP ID (used for v-lookup)	TSS Removal (%)	TP Removal (%)	TN Removal (%)	Fecal Coliform Removal** (%)	Pretreatment / Treatment	BMP Type
Vegetated Swale	1	70%	55%	50%	60%	Pretreatment	Vegetated Swale
Forebay**	2	25%	8%	3%	12%	Pretreatment	Forebay**
Deep Sump Catch Basin**	3	25%	8%	3%	12%	Pretreatment	Deep Sump Catch Basin**
Leaching Catch Basin	4	80%	55%	45%	90%	Pretreatment	Leaching Catch Basin
Wet Pond	5	80%	50%	30%	70%	Treatment	Wet Pond
Permeable Pavers	6	80%	60%	40%	95%	Treatment	Permeable Pavers
Raingarden	7	90%	60%	40%	70%	Treatment	Raingarden
Infiltration Basin	8	80%	65%	55%	95%	Treatment	Infiltration Basin
Infiltration Chambers**	9	80%	55%	40%	90%	Treatment	Infiltration Chambers**
Sand Organic Filters**	10	80%	30%	30%	90%	Treatment	Sand Organic Filters**
Gravel Wetland***	11	95%	64%	85%	85%	Treatment	Gravel Wetland***
Extended Dry Detention Basin	12	50%	20%	35%	60%	Treatment	Extended Dry Detention Basin
Constructed Wetlands	13	80%	50%	35%	60%	Treatment	Constructed Wetlands

EXAMPLE:
Pollutant Removal of BMPs in Series Equation:
If removal from the 1st BMP is >80%, the 2nd BMP efficiency shall be 50% of its normal efficiency.
If removal from the 1st BMP is <80%, the 2nd BMP efficiency shall be 75% of its normal efficiency.
Example: TSS load of 100lbs. 1st BMP removal 85%, 2nd BMP removal 40%.
TSS Removal = 100lbs * 85% = 85 lbs in 1st BMP
TSS Removal = (100lb-85lb) * (40% * .5) = 3 lbs in 2nd BMP
Net TSS Removal = 88 lbs

References:

Comparative Pollutant Removal Capability of Stormwater Treatment Practices, Technical Note #95 from Watershed Protection Techniques. 2(4): 515-520, Article 64. Retrieved July 22, 2005 from the World Wide Web: http://www.stormwatercenter.net/Practice/64-Comparative%20Pollutant%20Removal.pdf
Choi, J & Engel, B. Urban BMPs and Cost Estimation, Structural BMP Expected Pollutant Removal Efficiency & Median Event Mean Concentration for Urban Land Uses. US EPA. (1993) Handbook Urban Runoff Pollution and Control Planning. Retrieved July 22, 2005 from the World Wide Web: http://danpatch.ecn.purdue.edu/~jychoi/ubmp0/emc2.htm
Massachusetts Nonpoint Source Pollution Management Manual. Retrieved October 19, 2006 from the World Wide Web. Web: http://projects.geosyntec.com/NPSManual/
Pennsylvania Stormwater Best Management Practices Manual, Chapter 6 - Structural BMPs. Retrieved October 18, 2006 from the World Wide Web. Web: http://www.starkenvironmental.com/downloads/PADEP.pdf
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***Appendix E, Volume 1 of the New Hampshire Stormwater Manual, December 2008

Remarks / Comments:
BMP Volume for infiltration area assumes a 30% porosity in crushed stone. Model Calibration has not been completed to date

Model Entered By: _____ Date: _____ Signature: _____ Date Accepted: _____
Model Reviewed by: _____ Date: _____ Signature: _____ Date Accepted: _____
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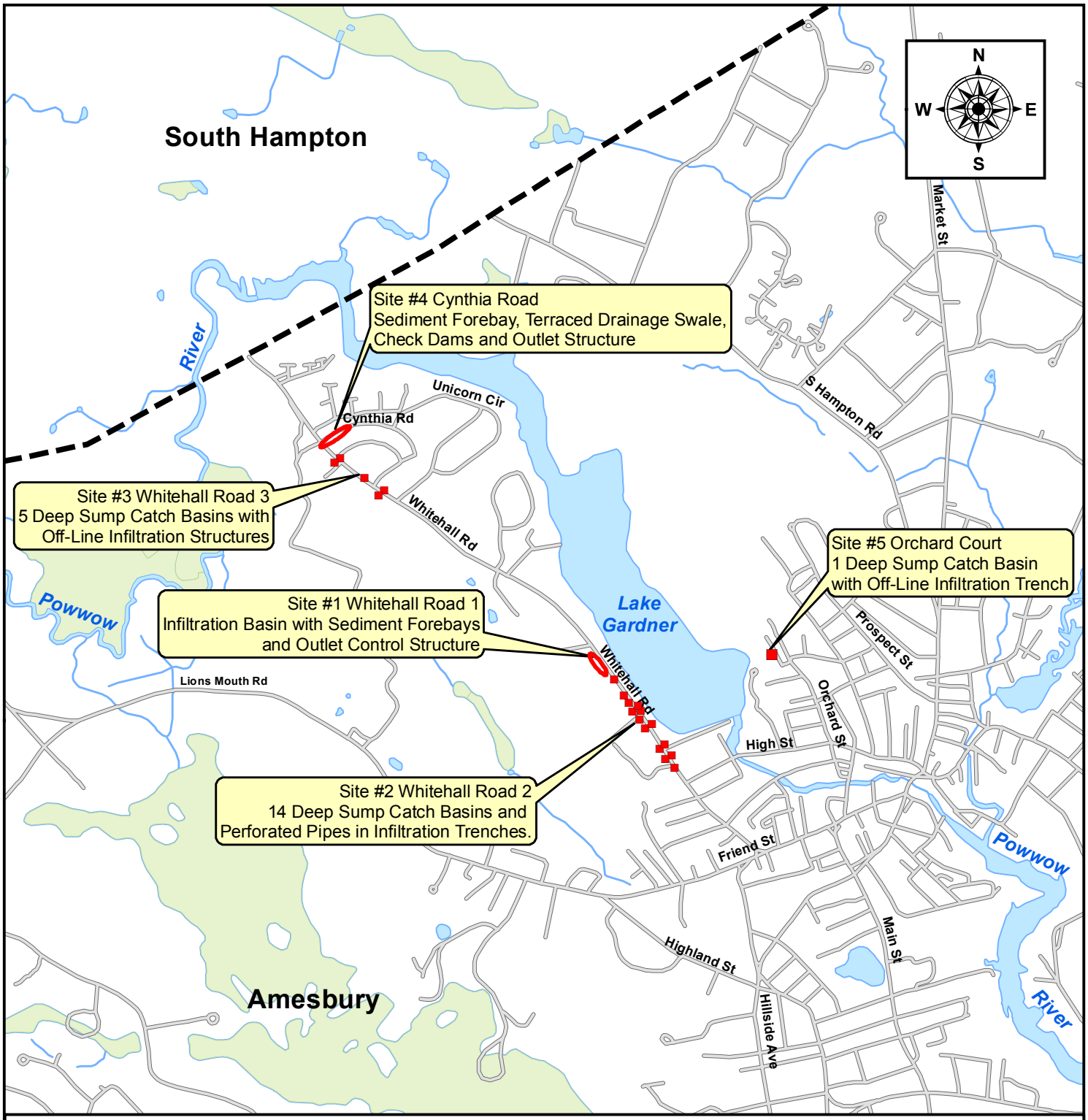
Summary Spreadsheet				
	Total Pollutant Removal			
	Annual TSS Removed	Annual TP Removed	Annual TN Removed	Annual Fecal Coliform
Grant Application Totals	8,300	8.0	35.0	690
Completed BMPs				
Whitehall Road (Sediment Forebay/Infiltration Basin; Deep Sump CBs with Infiltration Trench)	6,608	5.4	22.6	465
Whitehall/Cynthia Road (Off-line Infiltration Structures, Sediment Forebay, Terraced Drainage Swale with	4,370	4.3	21.4	339
Orchard Court **(**Deep Sump CB with Off-Line Infiltration Trench)	320	0.3	1.2	34
Total Pollutant Removal	**11,298**	**9.9**	**45.1**	**838**



Legend

- Deep Sump Catch Basin
- Infiltration Basin/Terraced Swale

Hydrography

- Surface Water
- Wetland Area
- Stream, Brook
- Town/State Boundary

0 1,000 2,000 3,000 Feet

Lake Gardner
Water Quality Improvements

Stormwater BMP Locations

City of Amesbury
Department of Public Works

Comprehensive Environmental Inc.

Task 2 Deliverables

CITY OF AMESBURY, MASSACHUSETTS

LAKE GARDNER
WATERSHED RESTORATION PROJECT

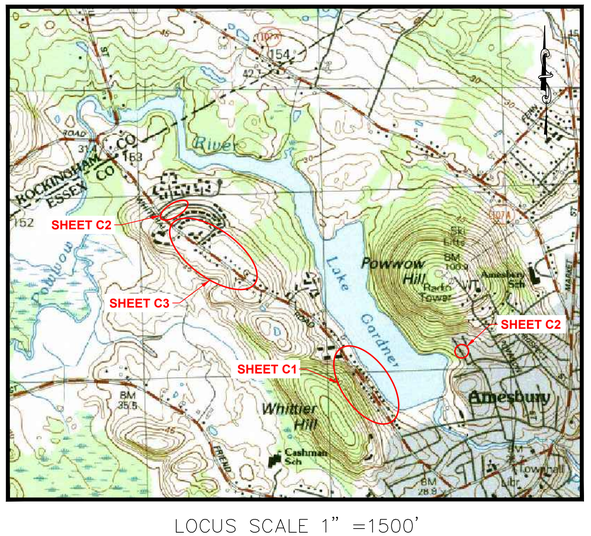
STORMWATER BMP LOCATIONS

MARCH 2015

PROJECT FUNDED THROUGH THE
U.S. EPA / MASSDEP s.319 NONPOINT
SOURCE POLLUTION GRANT PROGRAM

IN COORDINATION WITH

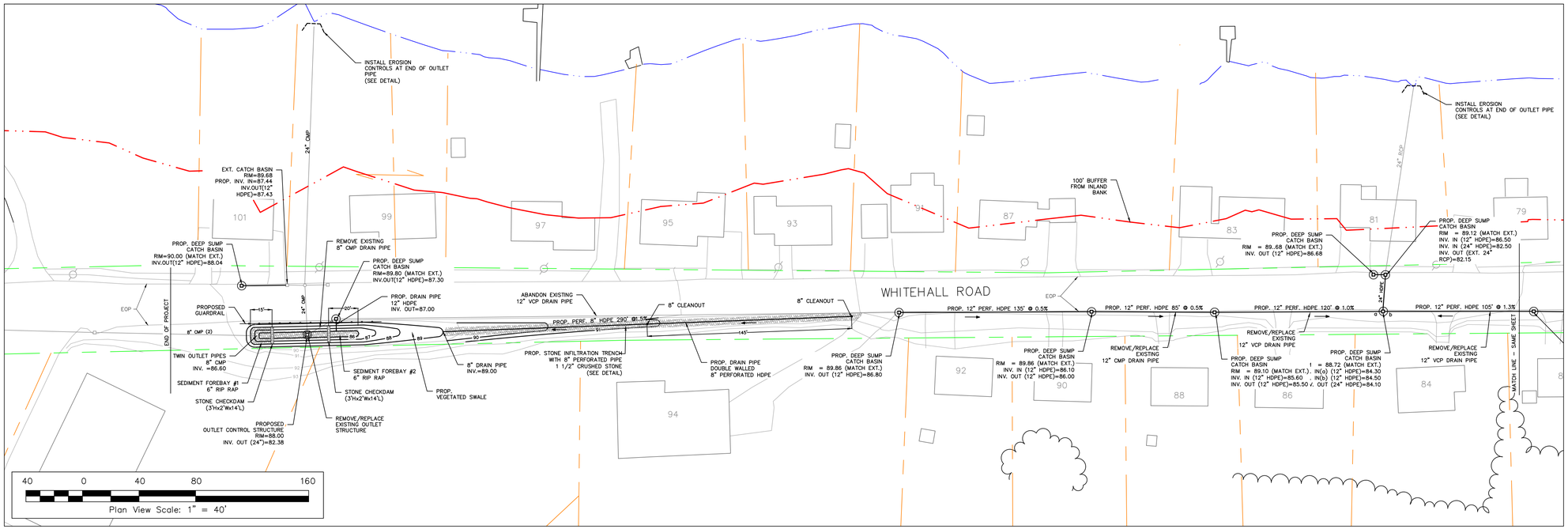
CITY OF AMESBURY
LAKE GARDNER IMPROVEMENT ASSOCIATION

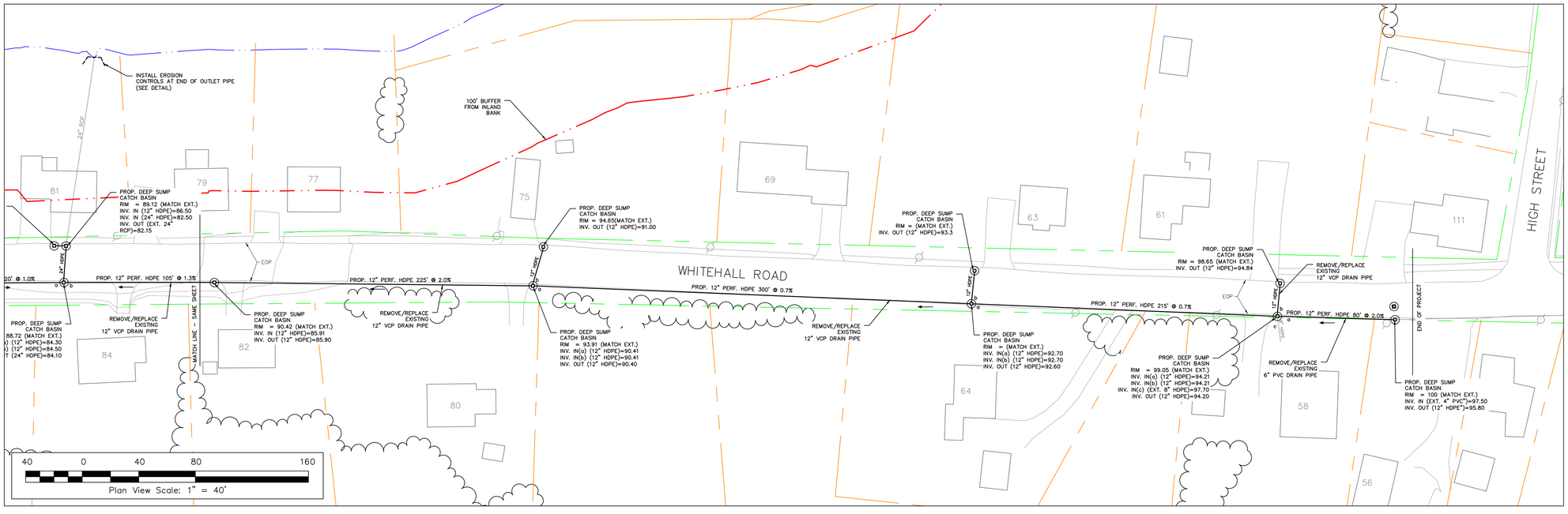


LOCUS SCALE 1" =1500'

SHEET	TITLE
C-1	WHITEHALL ROAD INFILTRATION BASIN, DEEP SUMP CATCH BASINS, AND INFILTRATION TRENCHES
C-2	CYNTHIA ROAD TERRACED VEGETATED SWALE AND ORCHARD COURT OFF-LINE INFILTRATION TRENCH
C-3	WHITEHALL ROAD OFF-LINE LEACHING STRUCTURES
C-4	DETAILS
C-5	DETAILS

COMPREHENSIVE ENVIRONMENTAL INCORPORATED • MARLBOROUGH, MASSACHUSETTS





General Notes

DIG SAFE
MA-ME-NH-RI-VT
1-888-344-7233
1-888-DIG-SAFE

No.	Revision/Issue	Date

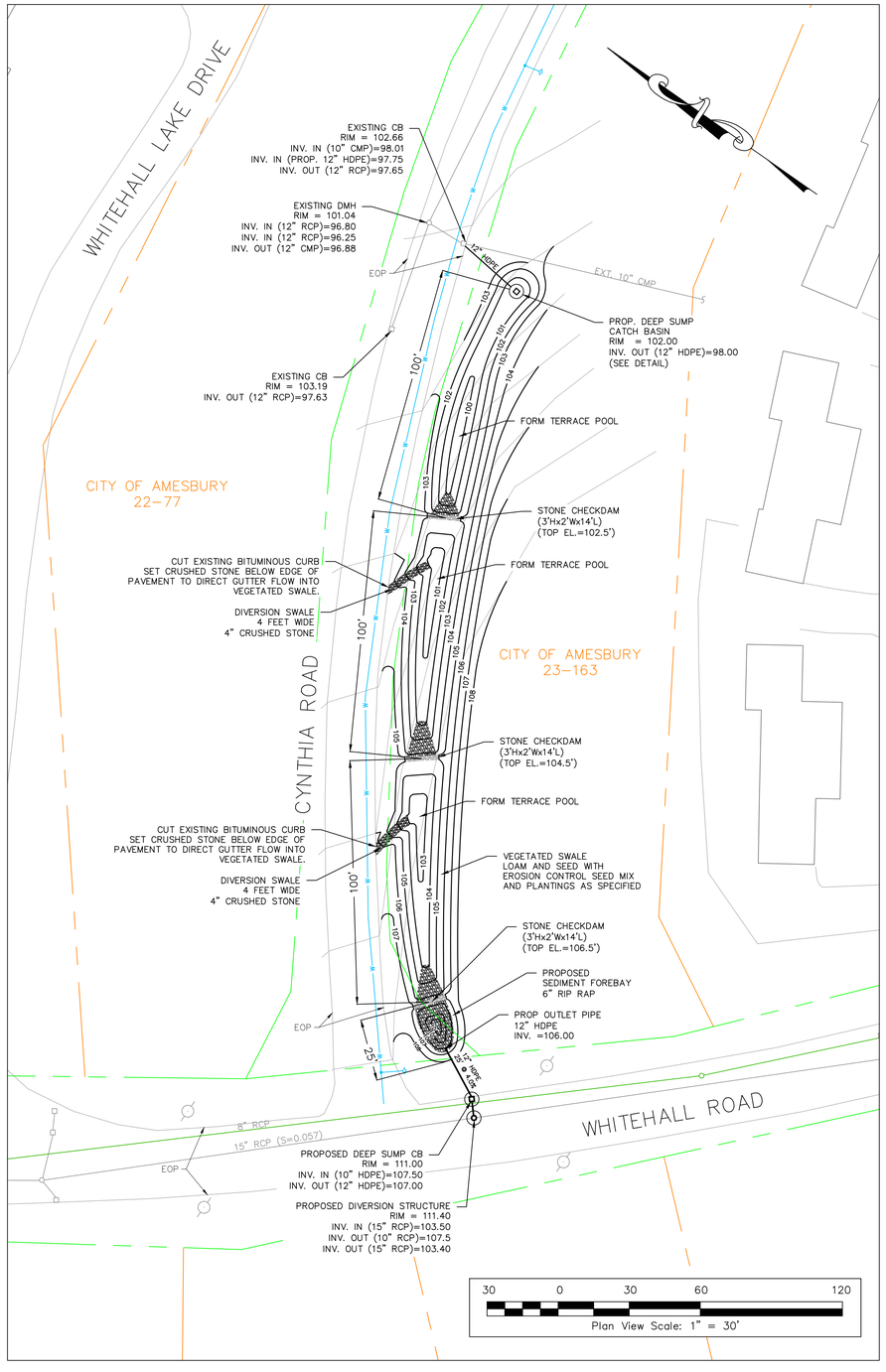
COMPREHENSIVE ENVIRONMENTAL INCORPORATED

225 CEDAR HILL STREET
MARLBOROUGH, MA 01752

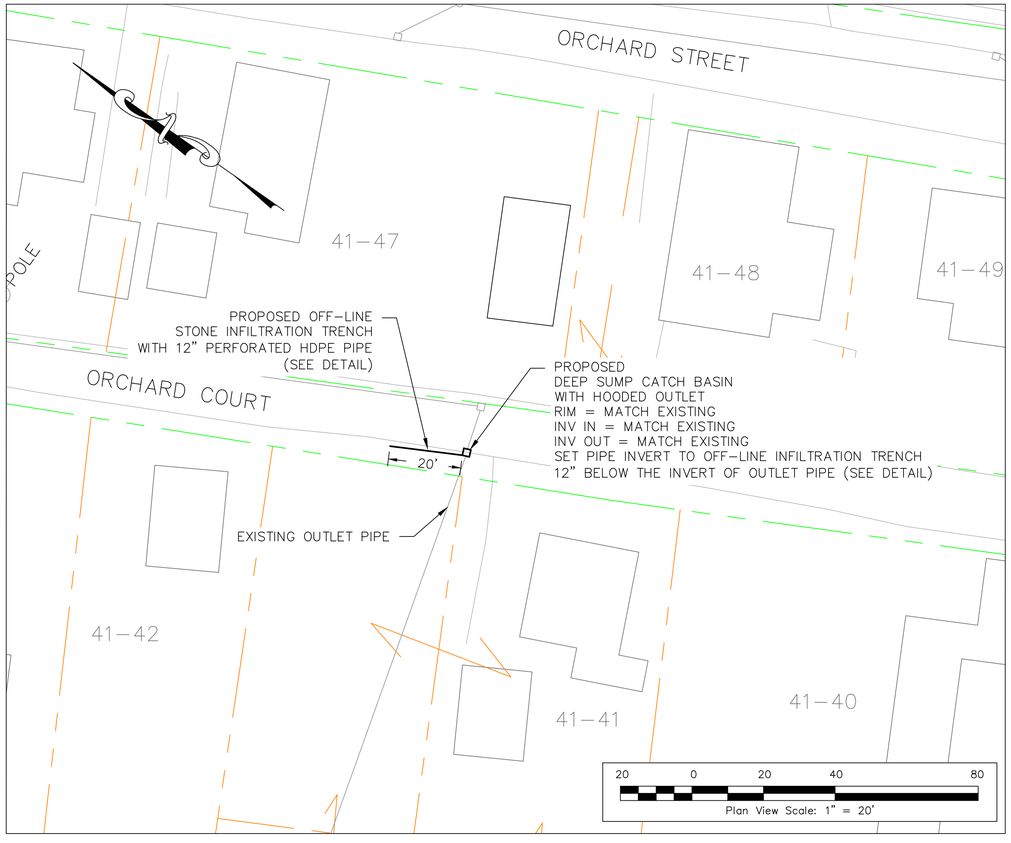
WHITEHALL ROAD
INFILTRATION BASIN,
DEEP SUMP CATCH BASINS,
AND INFILTRATION TRENCHES

CITY OF AMESBURY

Project: NO. 175-16 Date: MAR 2015	Sheet:
Designed by: CLB Checked by: MLL	C-1
Scale: As Shown	



CYNTHIA ROAD SEDIMENT FOREBAY AND TERRACED VEGETATED SWALE



ORCHARD COURT DEEP SUMP CATCH BASIN WITH OFF-LINE INFILTRATION TRENCH

General Notes

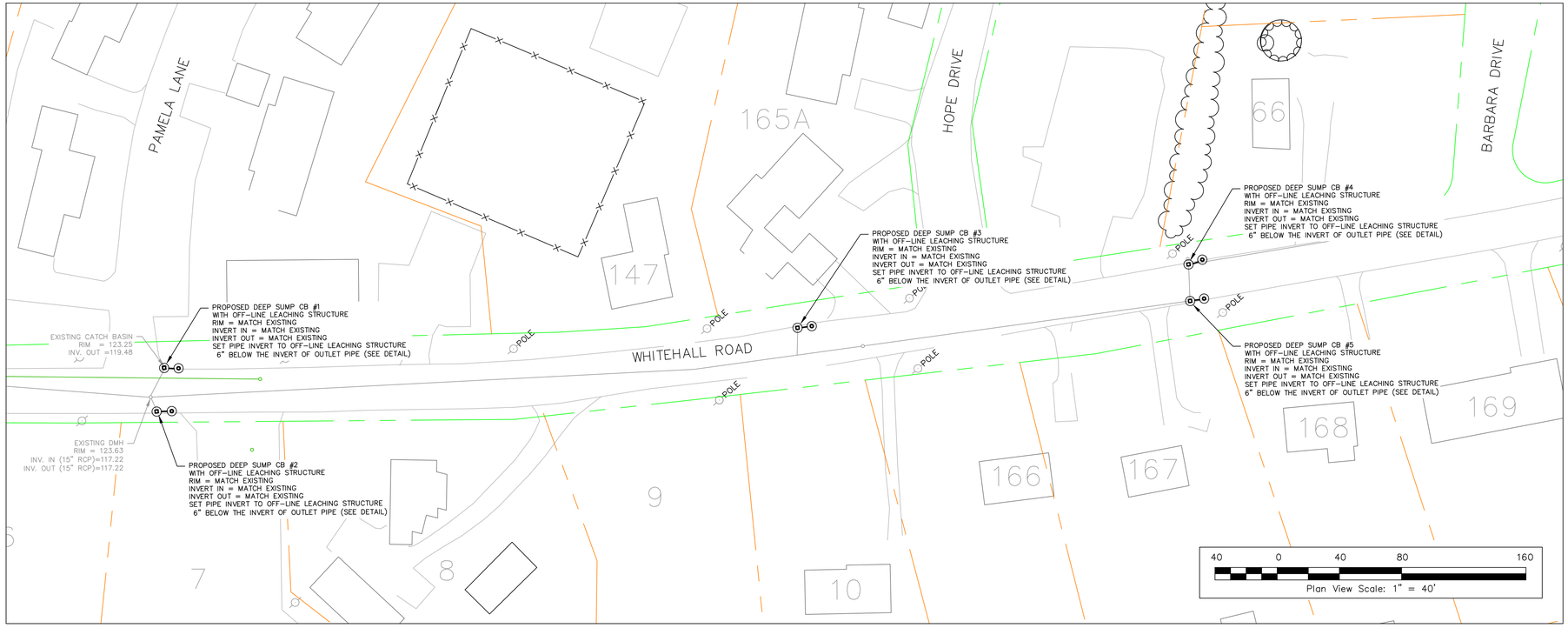
DIG SAFE
MA - 1-888-DIG-SAFE
ME - NH - RI - VT
1-888-344-7233

No.	Revision/Issue	Date

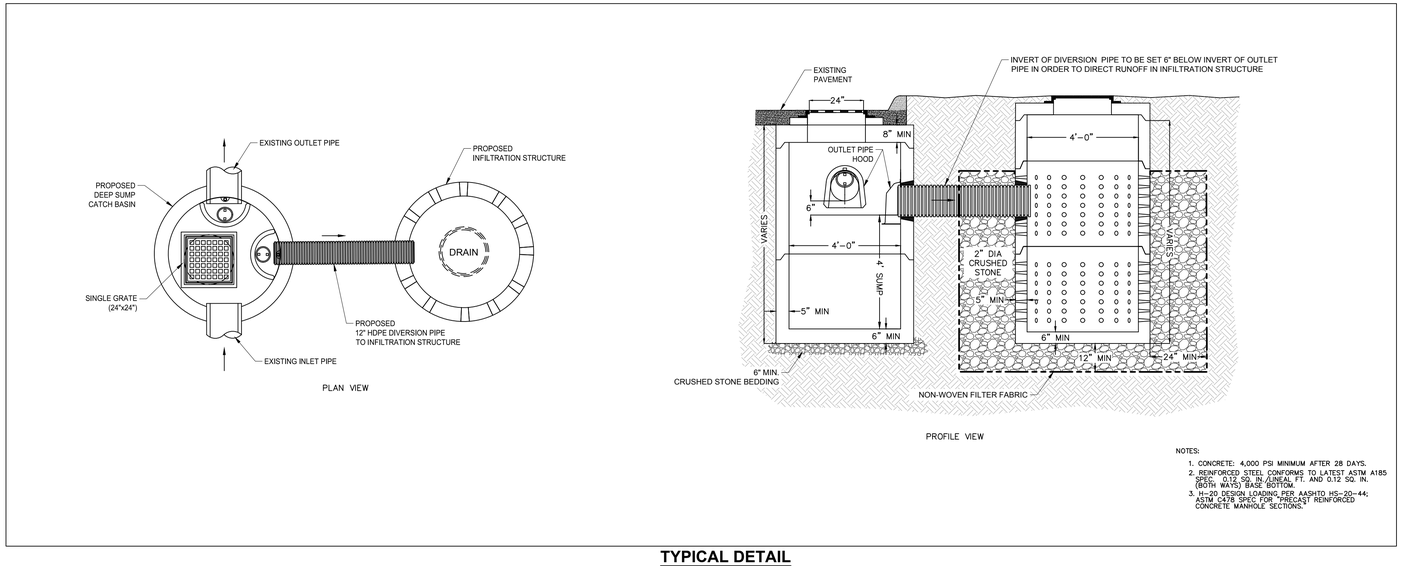
COMPREHENSIVE ENVIRONMENTAL INCORPORATED
225 CEDAR HILL STREET
MARLBOROUGH, MA 01752

CYNTHIA ROAD
TERRACED VEGETATED SWALE
AND
ORCHARD COURT
OFF-LINE INFILTRATION TRENCH
CITY OF AMESBURY

Project: NO. 175-16 Date: MAR 2015	Sheet: C-2
Designed by: CLB Checked by: MLL	
Scale: As Shown	



WHITEHALL ROAD DEEP SUMP CATCH BASINS
WITH OFF-LINE LEACHING STURCTURES



NOTES:
1. CONCRETE: 4,000 PSI MINIMUM AFTER 28 DAYS.
2. REINFORCED STEEL CONFORMS TO LATEST ASTM A185 SPEC. 0.12 SQ. IN./LINEAL FT. AND 0.12 SQ. IN. (BOTH WAYS) BASE BOTTOM.
3. H-20 DESIGN LOADING PER AASHTO HS-20-44; ASTM C478 SPEC FOR "PRECAST REINFORCED CONCRETE MANHOLE SECTIONS."

TYPICAL DETAIL
DEEP SUMP CATCH BASIN/OFF-LINE LEACHING STURCTURE
NOT TO SCALE

General Notes

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CALL BEFORE YOU DIG
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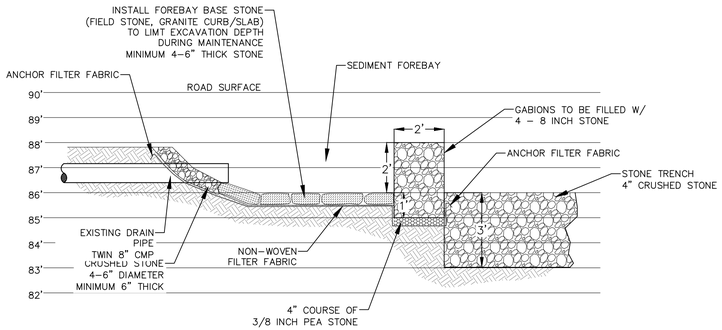
No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
225 CEDAR HILL STREET
MARLBOROUGH, MA 01752

WHITEHALL ROAD
OFF-LINE LEACHING
STRUCTURES
CITY OF AMESBURY

Project: NO. 175-16 Date: MAR 2015	Sheet: C-3
Designed by: CLB Checked by: MLL	
Scale: As Shown	



SEDIMENT BASIN #1

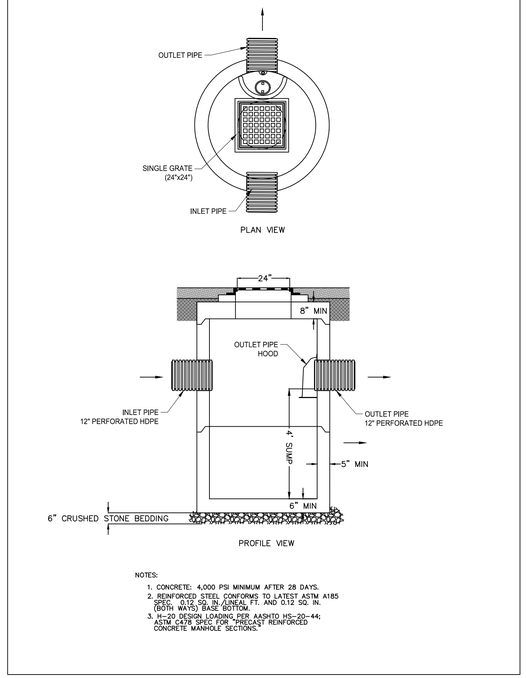
NOT TO SCALE

SEDIMENT BASIN #2

NOT TO SCALE

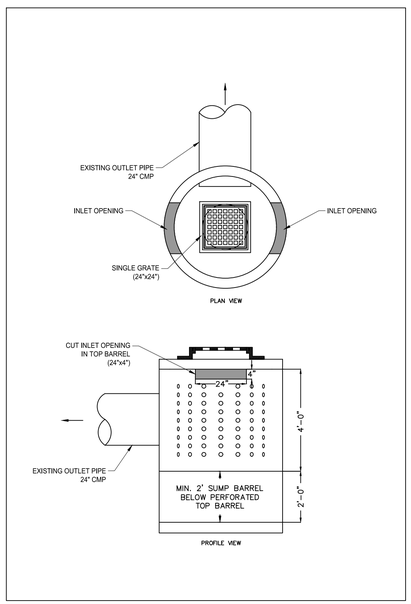
WHITEHALL ROAD
OUTLET CONTROL STRUCTURE

NOT TO SCALE



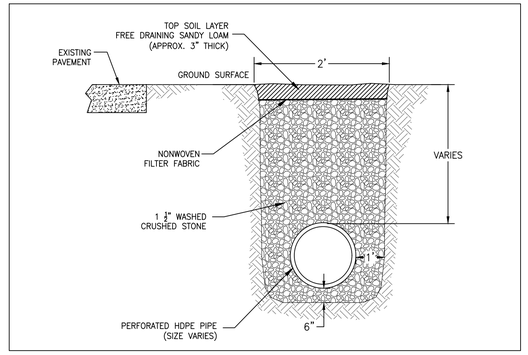
DEEP SUMP CATCH BASIN (TYP.)

NOT TO SCALE



WHITEHALL ROAD
OUTLET CONTROL STRUCTURE

NOT TO SCALE



WHITEHALL ROAD
INFILTRATION TRENCH PROFILE

NOT TO SCALE

General Notes

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

225 CEDAR HILL STREET
MARLBOROUGH, MA
01752

DETAILS

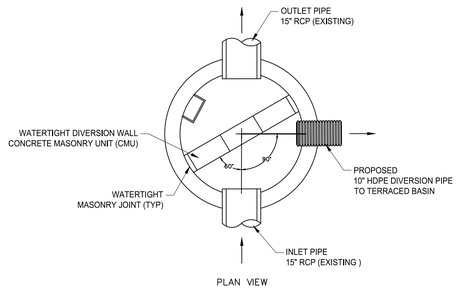
CITY OF AMESBURY

Project: NO. 175–16
Date: MAR 2015

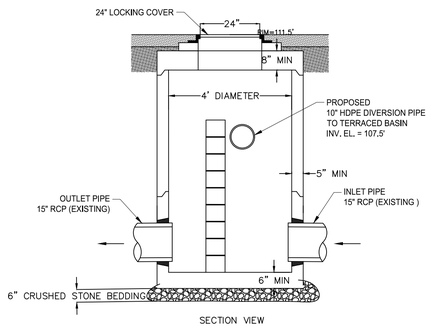
Designed by: CLB
Checked by: MLL

Scale: As Shown

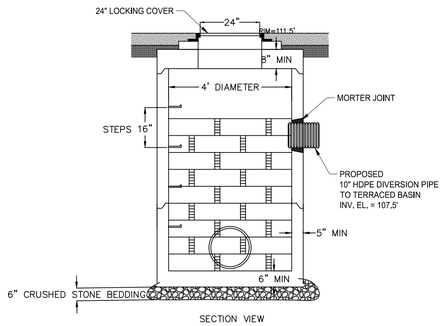
Sheet: C–4



PLAN VIEW



SECTION VIEW



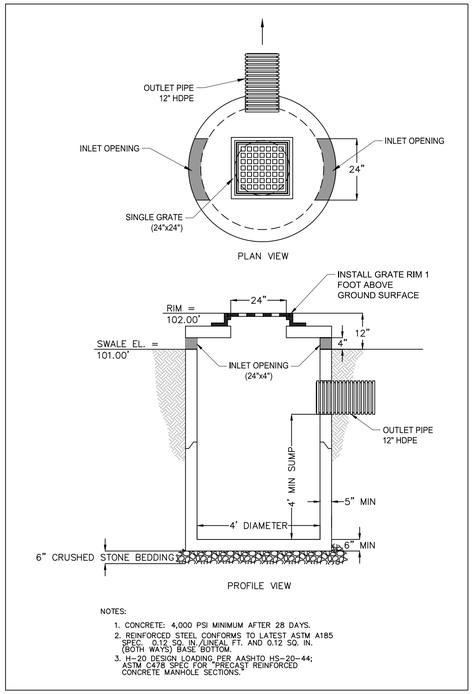
SECTION VIEW

NOTES:

1. CONCRETE: 4,000 PSI MINIMUM AFTER 28 DAYS.
2. REINFORCED STEEL CONFORMS TO LATEST ASTM A185 SPEC. 0.18 SQ. IN./LINEAL FT. AND 0.18 SQ. IN. (BOTH WAYS) BASE BOTTOM.
3. H-20 DESIGN LOADING PER AASHTO HS-20-44; ASTM C478 SPEC FOR "PRECAST REINFORCED CONCRETE MANHOLE SECTIONS."
4. STEEL REINFORCED COPOLYMER POLYPROPYLENE PLASTIC STEP CONFORMS TO LATEST ASTM C478 SPEC.

WHITEHALL ROAD DIVERSION STRUCTURE

NOT TO SCALE



PLAN VIEW

PROFILE VIEW

NOTES:

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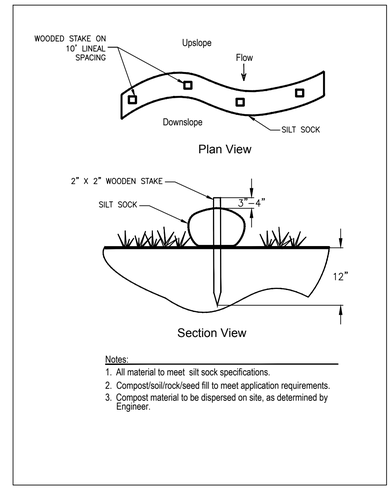
CYNTHIA ROAD OUTLET DEEP SUMP CATCH BASIN

NOT TO SCALE



Plan View

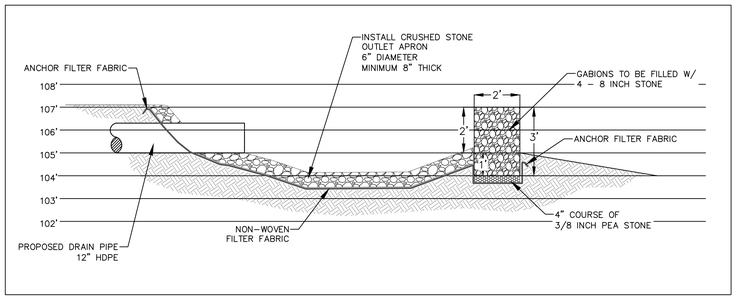
Section View

Notes:

1. All material to meet silt sock specifications.
2. Compost/soil/rock/seed fill to meet application requirements.
3. Compost material to be dispersed on site, as determined by Engineer.

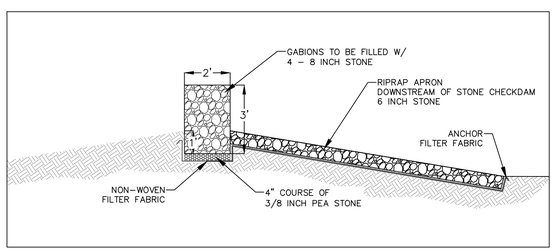
SILT SOCK EROSION CONTROL

NOT TO SCALE



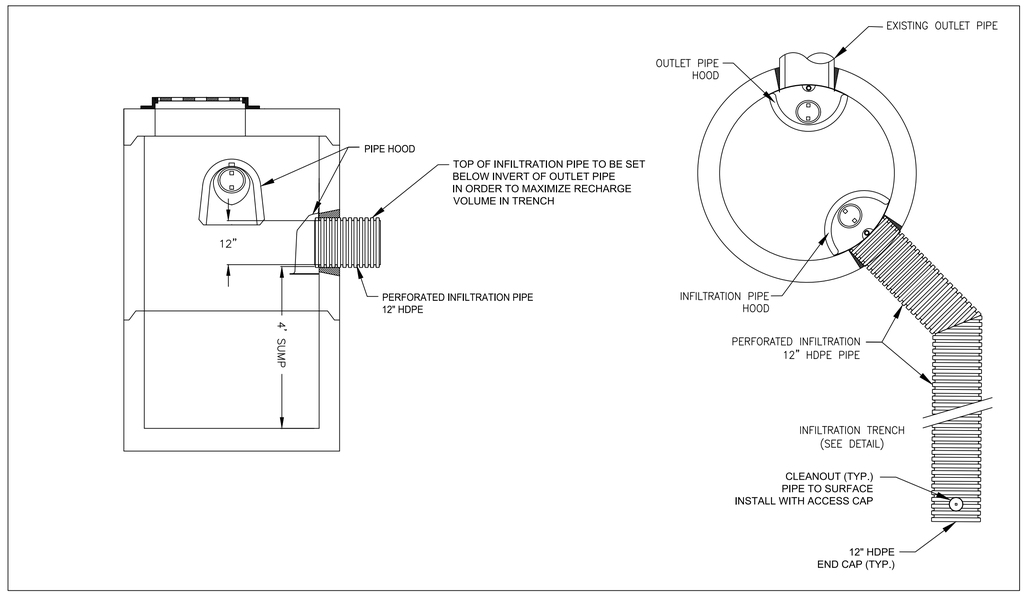
CYNTHIA ROAD SEDIMENT FOREBAY

NOT TO SCALE



CYNTHIA ROAD STONE GABION CHECKDAM (TYP.)

NOT TO SCALE



DEEP SUMP CATCH BASIN WITH OFFLINE INFILTRATION TRENCH

NOT TO SCALE

General Notes

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

225 CEDAR HILL STREET
MARLBOROUGH, MA 01752

DETAILS

CITY OF AMESBURY

Project: NO. 175-16
Date: MAR 2015
Designed by: CLB
Checked by: MLL
Scale: As Shown

Sheet: C-5

CITY OF AMESBURY, MASSACHUSETTS

LAKE GARDNER
WATERSHED RESTORATION PROJECT

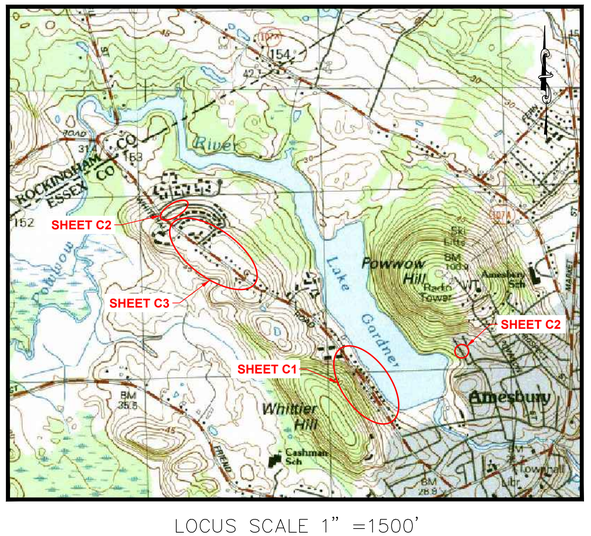
STORMWATER BMP LOCATIONS

AS-BUILT PLANS
August 2017

PROJECT FUNDED THROUGH THE
U.S. EPA / MASSDEP s.319 NONPOINT
SOURCE POLLUTION GRANT PROGRAM

IN COORDINATION WITH

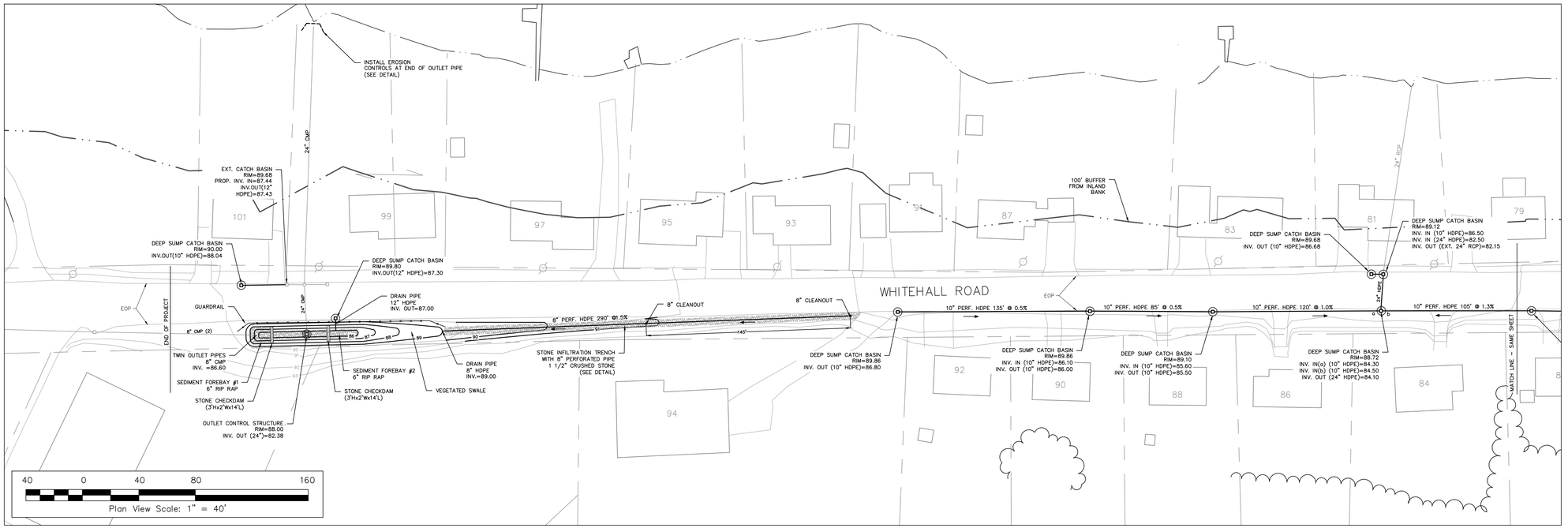
CITY OF AMESBURY
LAKE GARDNER IMPROVEMENT ASSOCIATION

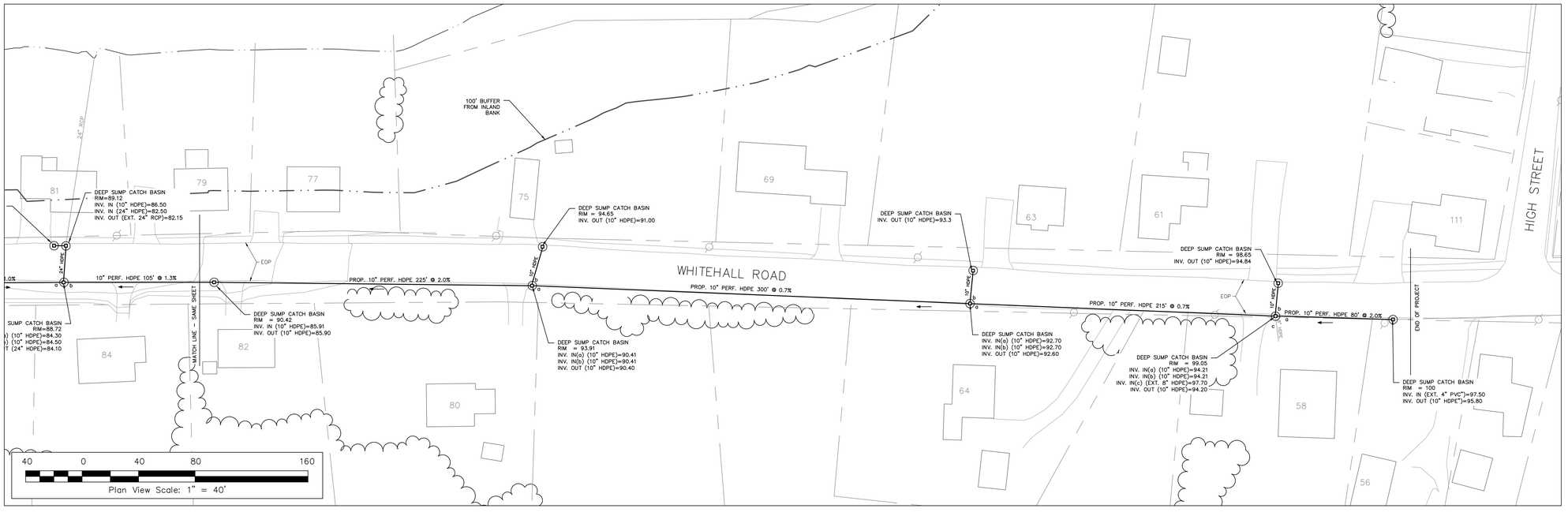


LOCUS SCALE 1" =1500'

SHEET	TITLE
C-1	WHITEHALL ROAD INFILTRATION BASIN, DEEP SUMP CATCH BASINS, AND INFILTRATION TRENCHES
C-2	CYNTHIA ROAD TERRACED VEGETATED SWALE AND ORCHARD COURT OFF-LINE INFILTRATION TRENCH
C-3	WHITEHALL ROAD OFF-LINE LEACHING STRUCTURES
C-4	DETAILS
C-5	DETAILS

COMPREHENSIVE ENVIRONMENTAL INCORPORATED • MARLBOROUGH, MASSACHUSETTS





General Notes

Matthew L. Lord
Licensed Professional Engineer
No. 10894

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No.	Revision/Issue	Date

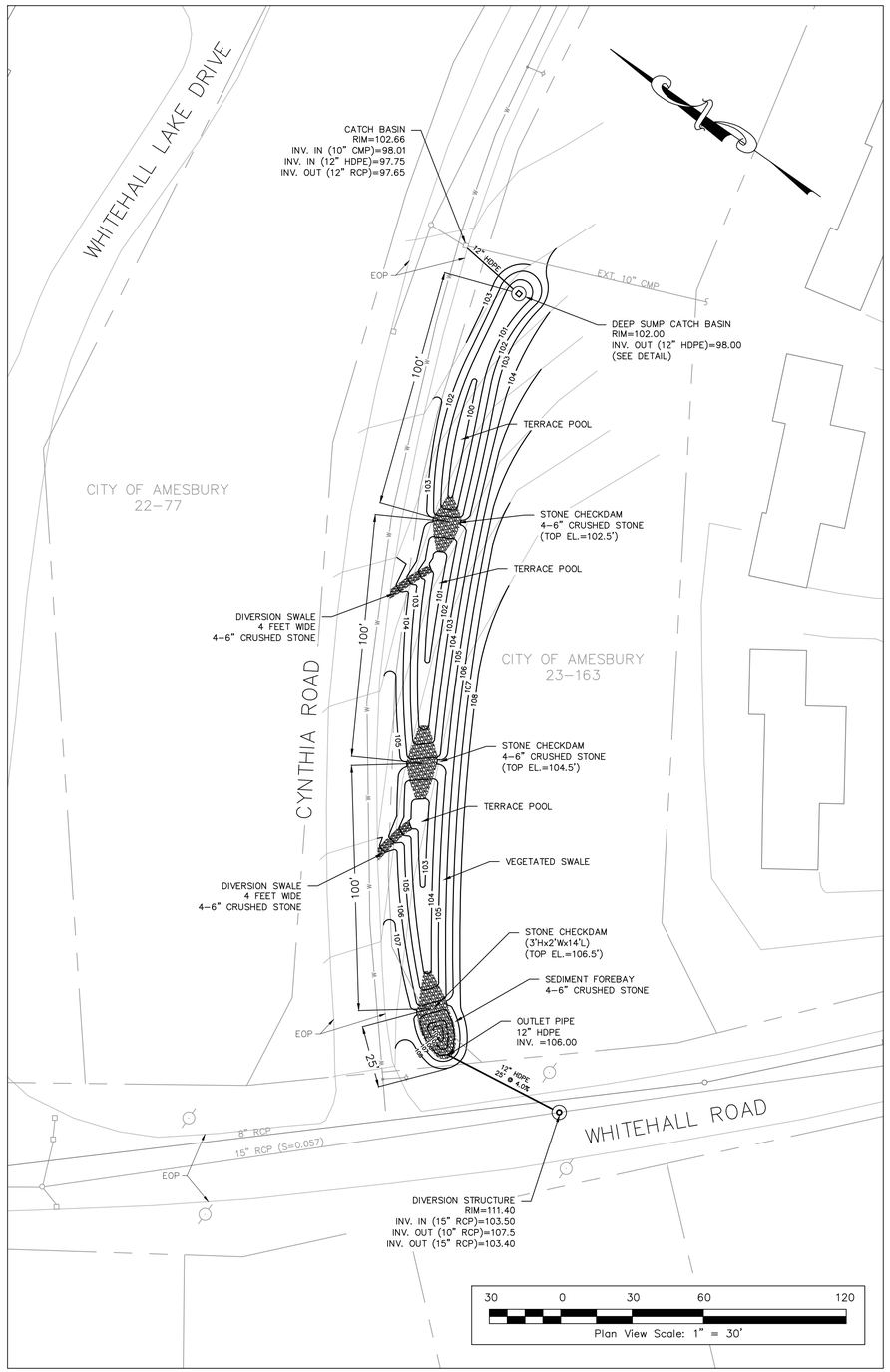
COMPREHENSIVE ENVIRONMENTAL INCORPORATED

225 CEDAR HILL STREET
MARLBOROUGH, MA 01752

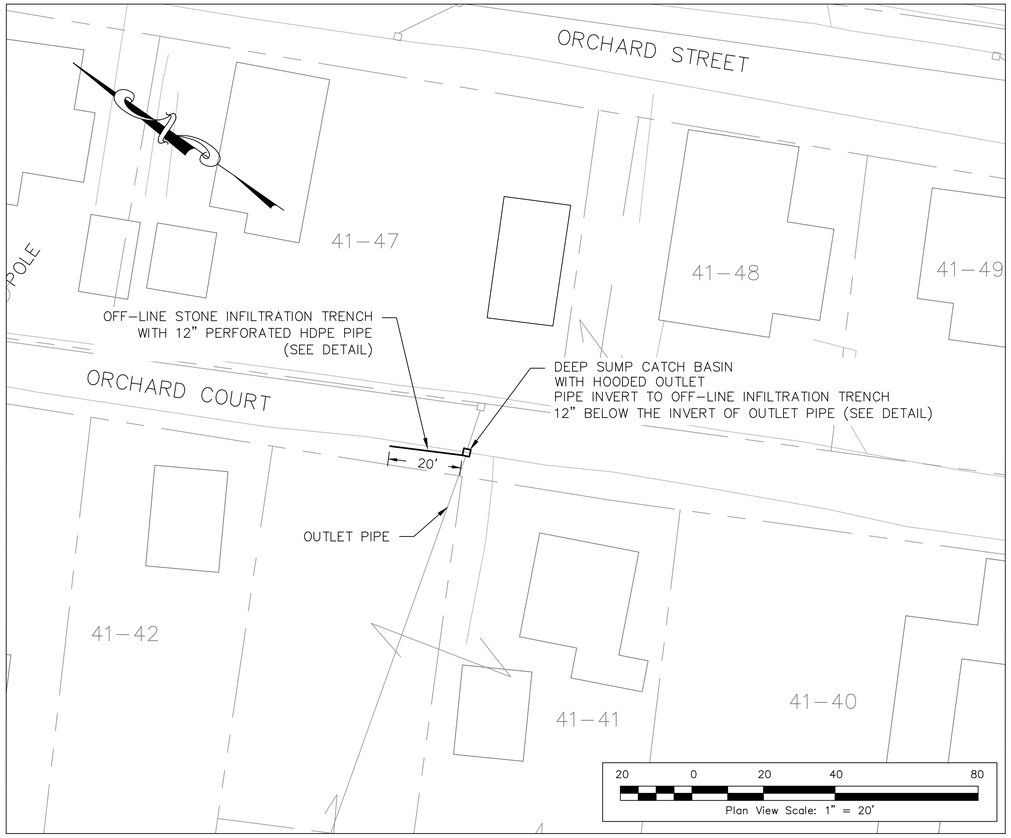
WHITEHALL ROAD
INFILTRATION BASIN,
DEEP SUMP CATCH BASINS,
AND INFILTRATION TRENCHES

CITY OF AMESBURY

Project: NO. 175-16 Date: AUG 2017	Sheet:
Designed by: CLB Checked by: MLL	C-1
Scale: As Shown	



CYNTHIA ROAD SEDIMENT FOREBAY AND TERRACED VEGETATED SWALE



ORCHARD COURT DEEP SUMP CATCH BASIN WITH OFF-LINE INFILTRATION TRENCH

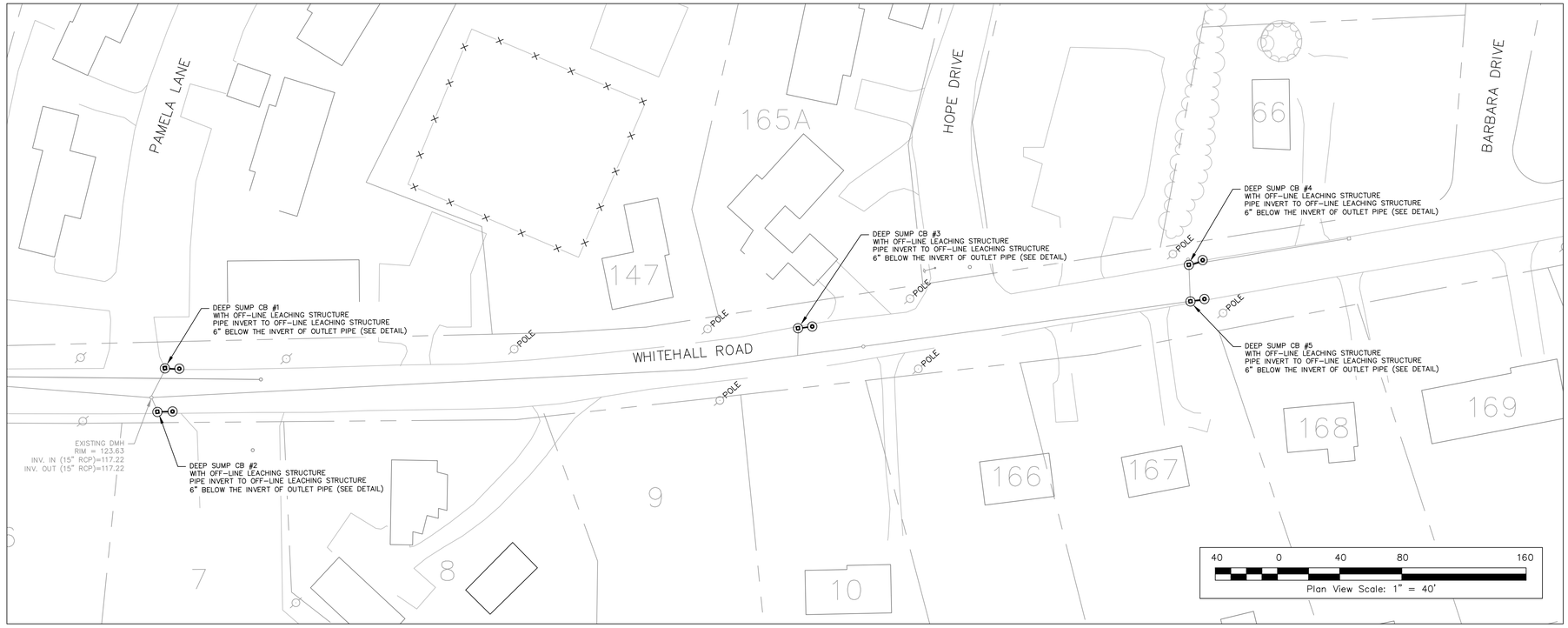
General Notes

No.	Revision/Issue	Date

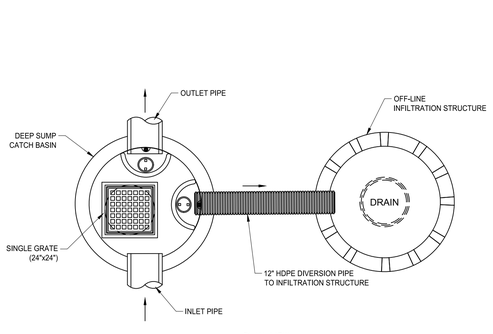
COMPREHENSIVE ENVIRONMENTAL INCORPORATED
225 CEDAR HILL STREET
MARLBOROUGH, MA 01752

CYNTHIA ROAD
TERRACED VEGETATED SWALE
AND
ORCHARD COURT
OFF-LINE INFILTRATION TRENCH
CITY OF AMESBURY

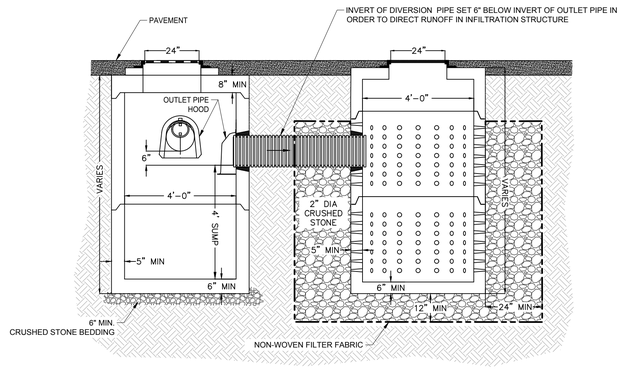
Project: NO. 175-16 Date: AUG 2017	Sheet:
Designed by: CLB Checked by: MLL	C-2
Scale: As Shown	



WHITEHALL ROAD DEEP SUMP CATCH BASINS
WITH OFF-LINE LEACHING STURCTURES



PLAN VIEW



PROFILE VIEW

NOTES:

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2. REINFORCED STEEL CONFORMS TO LATEST ASTM A185 SPEC. 0.12 SQ IN./LINEAL FT. AND 0.12 SQ. IN. (BOTH WAYS) BASE BOTTOM.
3. H-20 DESIGN LOADING PER AASHTO HS-20-44; ASTM C478 SPEC FOR "PRECAST REINFORCED CONCRETE MANHOLE SECTIONS."

TYPICAL DETAIL
DEEP SUMP CATCH BASIN/OFF-LINE LEACHING STURCTURE

NOT TO SCALE

General Notes

Matthew L. Lundgren
No. 40894
REGISTERED PROFESSIONAL ENGINEER

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1-888-DIG-SAFE

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

225 CEDAR HILL STREET
MARLBOROUGH, MA 01752

WHITEHALL ROAD
OFF-LINE LEACHING
STRUCTURES

CITY OF AMESBURY

Project: NO. 175-16 Date: AUG 2017	Sheet:
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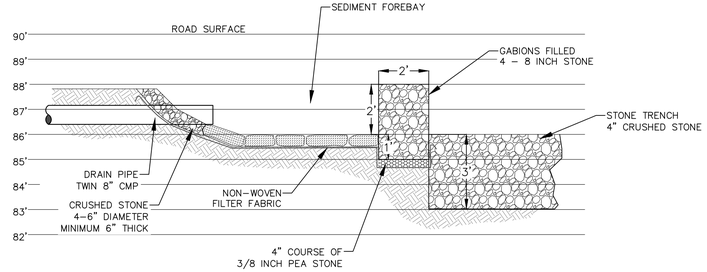
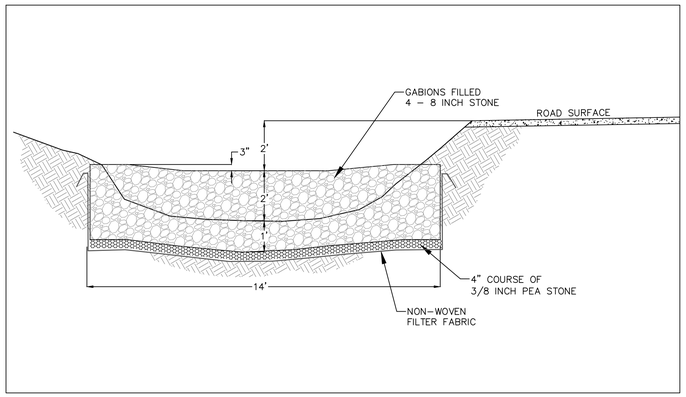


SEDIMENT BASIN #1

NOT TO SCALE



SEDIMENT BASIN #2

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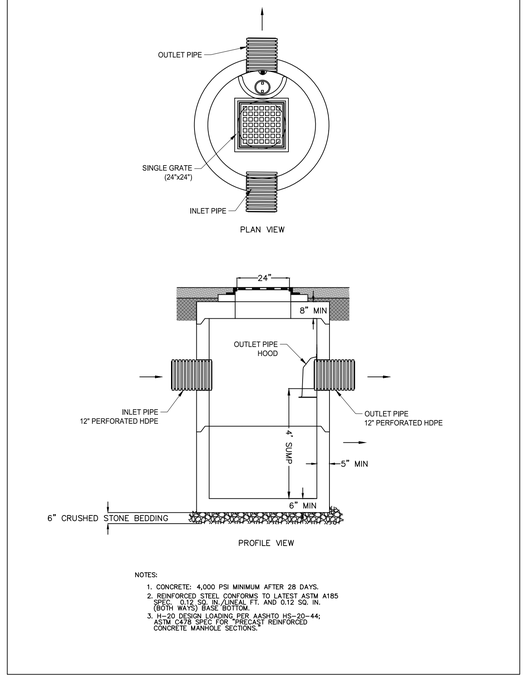

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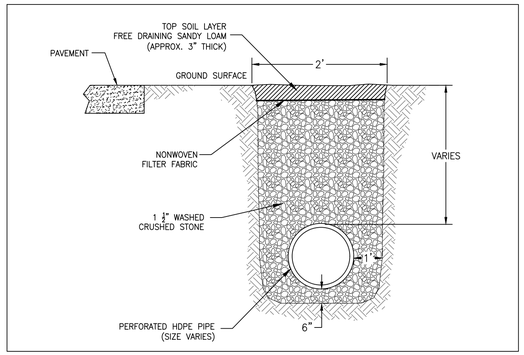
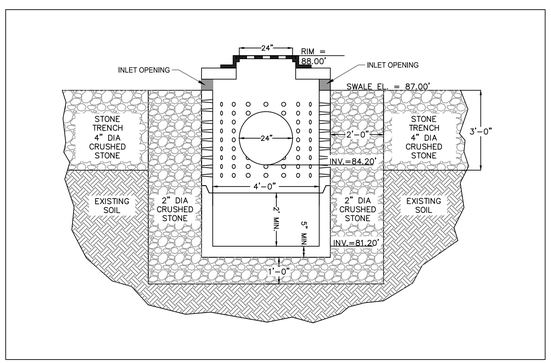
DEEP SUMP CATCH BASIN (TYP.)

NOT TO SCALE



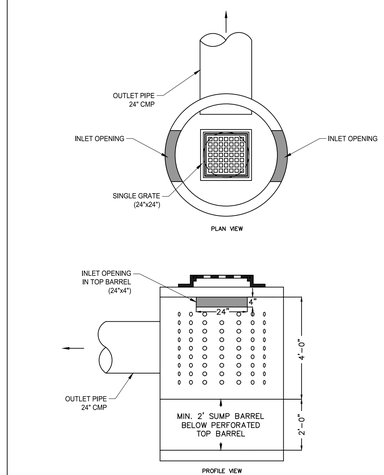
WHITEHALL ROAD
INFILTRATION TRENCH PROFILE

NOT TO SCALE



WHITEHALL ROAD
OUTLET CONTROL STRUCTURE

NOT TO SCALE



WHITEHALL ROAD
OUTLET CONTROL STRUCTURE

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General Notes

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COMPREHENSIVE ENVIRONMENTAL INCORPORATED

225 CEDAR HILL STREET
MARLBOROUGH, MA
01752

DETAILS

CITY OF AMESBURY

Project: NO. 175–16
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Designed by: CLB
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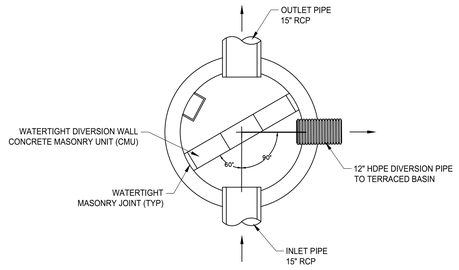
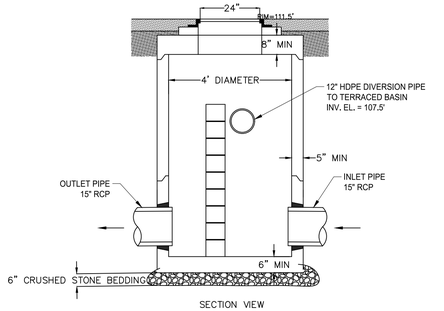
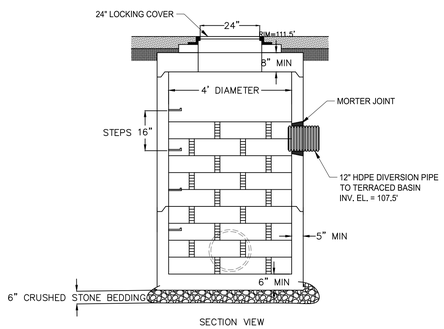
Sheet:
C–4



PLAN VIEW



SECTION VIEW



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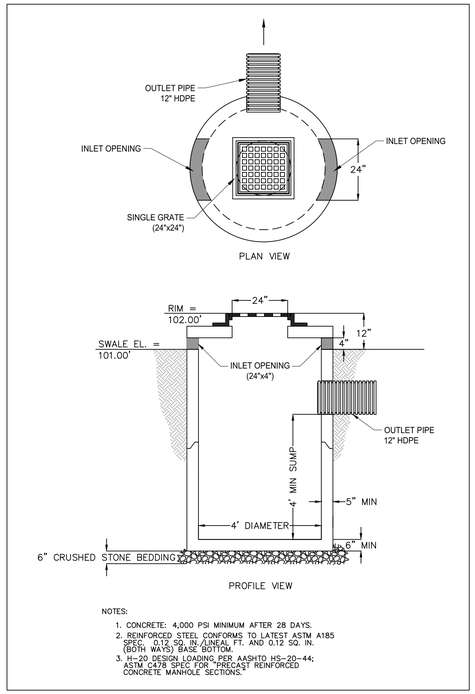
WHITEHALL ROAD DIVERSION STRUCTURE

NOT TO SCALE



PLAN VIEW

PROFILE VIEW

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CYNTHIA ROAD OUTLET DEEP SUMP CATCH BASIN

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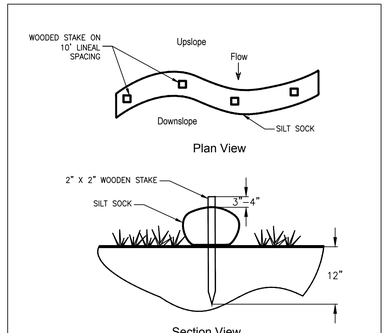

Plan View

Section View

Notes:

1. All material to meet silt sock specifications.
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SILT SOCK EROSION CONTROL

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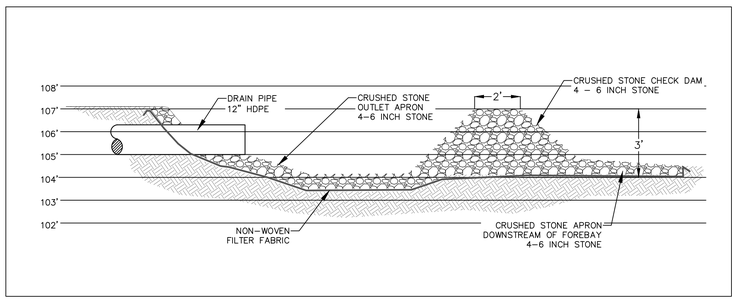
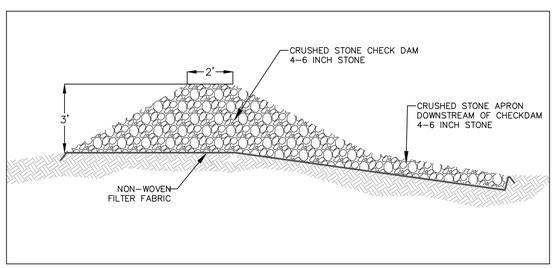


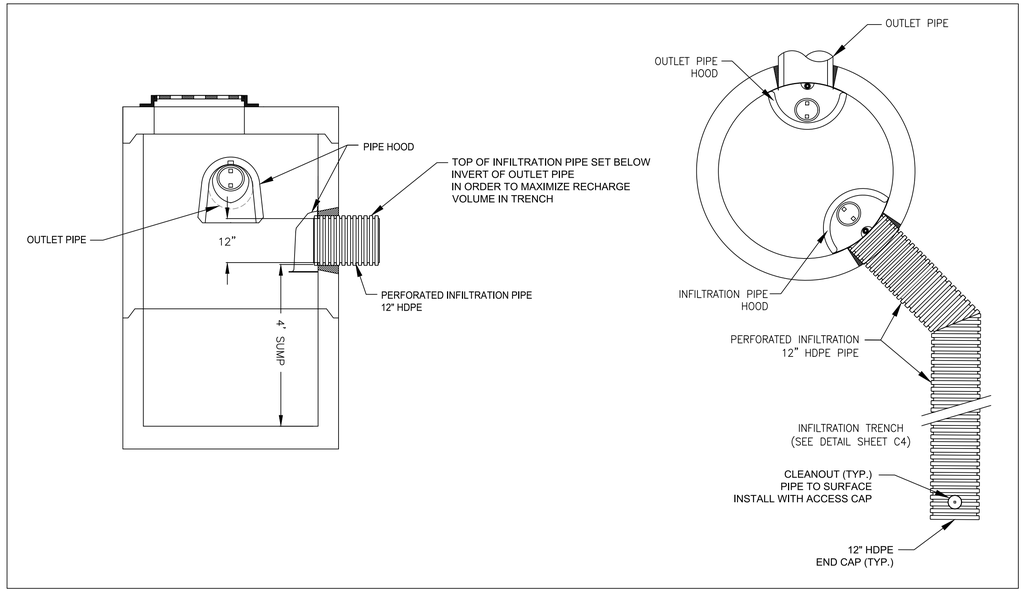
CYNTHIA ROAD SEDIMENT FOREBAY

NOT TO SCALE



CYNTHIA ROAD STONE CHECKDAM (TYP.)

NOT TO SCALE



DEEP SUMP CATCH BASIN WITH OFFLINE INFILTRATION TRENCH

NOT TO SCALE

General Notes

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COMPREHENSIVE ENVIRONMENTAL INCORPORATED

225 CEDAR HILL STREET
MARLBOROUGH, MA
01752

DETAILS

CITY OF AMESBURY

Project: NO. 175-16 Date: AUG 2017	Sheet:
Designed by: CLB Checked by: MLL	C-5
Scale: As Shown	

COMPREHENSIVE
ENVIRONMENTAL
INCORPORATED

- Engineering
- Design
- Construction
- Inspection

Responsive service, cost-effective solutions, technical excellence

- Drainage & Flooding
- Energy & Sustainability
- Hazardous Waste
- Permitting & NEPA
- Stormwater & LID
- Transportation
- Water & Wastewater
- Watershed Restoration

August 16, 2017

Mr. Robert Desmarais, P.E.
Director of Public Works
Town of Amesbury
39 South Hunt Road
Amesbury, MA 01913

RE: PROJECT # 14-05/319
CONSTRUCTION COMPLETION

Dear Mr. Desmarais:

The purpose of this letter is to provide documentation that the Lake Gardner stormwater BMPs, funded by the U.S. EPA and MassDEP s.319 Nonpoint Source Protection Grant Program, as amended, were constructed in accordance with the project goal and in conformance with the design intent to reduce nonpoint source pollution entering Lake Gardner and help improve water quality.

If you have any questions or comments, please feel free to contact me at 800.725.2550 or at mlundsted@ceiengineers.com.

Sincerely,

COMPREHENSIVE ENVIRONMENTAL INC.

Matthew Lundsted, P.E., CFM
Principal Engineer

225 Cedar Hill Street, Marlborough, Massachusetts 01752 508-281-5160 Fax: 508-281-5136
21 Depot Street, Merrimack, New Hampshire 03054 603-424-8444 Fax: 603-424-8441
Gateway Crossing, 1 Hartford Square-East, New Britain, Connecticut 06052 860-224-0442
www.ceiengineers.com

Site 1 - Before
Infiltration Basin with Sediment Forebays and Outlet Control Structure

Site 1 - Before
Infiltration Basin with Sediment Forebays and Outlet Control Structure

Site 1
Infiltration Basin with Sediment Forebays and Outlet Control Structure

Site 1
Infiltration Basin with Sediment Forebays and Outlet Control Structure

Site 2
Deep Sump Catch Basins and Perforated Pipes in Infiltration Trenches

Site 2
Deep Sump Catch Basins and Perforated Pipes in Infiltration Trenches

Site 3
Deep Sump Catch Basins and Off-Line Infiltration Structures

Site 3
Deep Sump Catch Basins and Off-Line Infiltration Structures

Site 4 - Before
Sediment Forebay, Terraced Drainage Swale, Check Dams

Site 4 - Before
Sediment Forebay, Terraced Drainage Swale, Check Dams

Site 4
Sediment Forebay

Site 4
Sediment Forebay, Terraced Drainage Swale, Check Dams

Site 4
Terraced Drainage Swale, Check Dams

Site 4
Outlet Structures

Site 5
Deep Sump Catch Basin with Off-Line Infiltration Trench

Task 3 Deliverables

Lake Gardner & Powow River
Nonpoint Source Improvement Project

Stormwater BMP Implementation Project
O&M Plan

Town of Amesbury

June 2017

Prepared By:

Comprehensive Environmental Inc.

Lake Gardner is a 93-acre lake that lies between several reaches of the Powow River in the Merrimack River Watershed. It was formed when the Powow River was impounded for industrial mill use in downtown Amesbury in the late 1800s. The Powow River is a Class A waterbody and listed as a Category 5 impaired waterbody on the 2010 303(d) list of impaired waters for pathogens (fecal coliform), total suspended solids and turbidity. Despite the activities promulgated by the Town of Amesbury and the Lake Gardner Improvement Association, periodic beach closures due to elevated bacteria levels, algal blooms, sedimentation and nuisance aquatic weeds plague Lake Gardner. In 2009, the Town of Amesbury was awarded a 604(b) Water Quality Management Planning Grant to obtain water quality data and assess land use activities to develop a long-term restoration plan to address sources of bacteria. Assessment activities were completed within the Lake Gardner Watershed and included the upstream segments of the Powow River with a final report completed in May, 2011. Recommendations were provided for both structural and non-structural Best Management Practices (BMPs) with prioritized locations.

This grant project implements several of the prioritized BMPs to reduce pathogens, total suspended solids and nutrients within the Lake Gardner and Powow River Watersheds.

The goal of the Lake Gardner & Powow River Nonpoint Source Improvement Project is to improve water quality through the implementation of stormwater Best Management Practices (BMPs). The BMPs are designed to treat runoff and restore some of the watershed's pre-development hydrology. This project is part of a DEP s.319 Nonpoint Source Pollution Grant to retrofit several drainage systems and construct new stormwater BMPs in the Lake Gardner and Powow River watershed.

As part of the work completed under the grant, the Amesbury Department of Public Works will be responsible for the maintenance of the stormwater BMPs located in the Town of Amesbury. These BMPs are designed to collect stormwater runoff from adjacent road surfaces and provide pollutant removal through vegetative treatment and sediment collection. Locations of the stormwater BMPs are included in the attached map.

BMPs to be utilized include:

- 14 Deep Sump Catch Basins, Perforated Pipes in Infiltration Trenches.
- Infiltration Basin with Sediment Forebays and Outlet Control Structure
- 5 Deep Sump Catch Basins and Off-Line Infiltration Structures
- Sediment Forebay, Terraced Drainage Swale, Check Dams and Outlet Structure
- Deep Sump CB with Off-Line Infiltration Trench

BMP Owner:

Town of Amesbury

O&M Responsible Party:

Amesbury Department of Public Works

Schedule for Inspection & Maintenance:

See attached O&M schedule for each specific BMP.

List of O&M Tasks:

See attached O&M procedures for each specific BMP.

Source of Long-Term O&M Funding:

The Amesbury Department of Public Works is committed to maintaining all public stormwater BMPs and drainage conveyances. BMPs will be maintained as part of the annual department budget for a minimum of 7 years.

BMP Locations:

See attached map.

Plan Elements:

1. O&M Plan procedures
2. BMP maintenance logs
3. Site Map

BMP Lifespan:

Site specific BMPs for this location are expected to last indefinitely given that proper O&M activities are followed.

Deep Sump Catch Basins and Infiltration Pipes		
Procedure	**Objective**	**Frequency**
Surface Inspection	Remove sediment and debris from the surface grate to prevent street flooding.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections.
Deep Sump Catch Basin Interior and Sump Sediment Removal	Remove sediment and debris from deep-sump catch basin to prevent it from discharging to infiltration pipe.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections. (minimum annually)
Outlet Hood Inspections	Visually inspect condition of outlet hood (i.e. cracks, missing bolts, and debris.) If debris is present, remove and discard.	Annually
Perforated Pipe Inspection	Maintain flow and infiltration capacity of the perforated pipes. Inspect and remove sediment and debris to prevent clogging of perforations.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years inspections.
Perforated Pipe Flushing	Maintain flow and infiltration capacity of the perforated pipes and infiltration trench. Inspect and flush infiltration pipe with hydraulic jet to remove sediment accumulation.	Establish a specific schedule based on previous years inspections.

Location Whitehall Road

Notes:
Deep sump catch basins and infiltration pipes should be maintained at a minimum on a yearly basis. However, if maintenance is only conducted once per year, it is optimally performed after winter sanding has terminated.

The accumulated sediment, leaves, and debris from the surface grate are to be removed and disposed of in an approved manner and in such a way as to not cause harm to the environment.

Deep Sump Catch Basins and Infiltration Pipes						
Maintenance Record						
Location (Road Name)	Date	Condition of BMP	Maintenance Performed, Material Removed	Maintenance Personnel	Volume of Sediment Removed (cf)	Comments

Sediment Forebay and Infiltration Basin		
Procedure	**Objective**	**Frequency**
Sediment Removal	Remove sediment >2" from the forebay and infiltration basin to prevent it from entering the outlet structure and discharging to Lake Gardner and inhibiting BMP capacity.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections. After first year, performed inspection on the same routine maintenance schedule for City catch basin cleaning.
Structural Inspection	Visually inspect slope of bank and check for soil erosion. Visually inspect forebay stones and infiltration basin side slopes to make sure they are not being undermined or displaced. Regrade or replace stone as necessary.	Performed quarterly for the first year and after heavy storms. After first year, performed inspection on the same routine maintenance schedule for City catch basin cleaning. Do not allow sediment build up to 6 inches.
Debris and Litter Removal	Remove for aesthetics and contribution of downstream floatables problem.	Perform quarterly or following the first 2 significant storm events (>.25") for the first year. Establish a specific schedule based on first year accumulations (min. 1 year frequency).
Vegetation Removal	Visually inspect the infiltrstion basin for excessive vegetation growth accumulating in stone voids, which impedes infiltration capacity . Prune plants and remove weeds as needed to maintain flow and infiltration.	Spring and Fall or as necessary. Performed inspection on the same routine maintenance schedule for City catch basin cleaning.

Locations: Whitehall Road

Notes:
Forebays should be maintained at a minimum on a yearly basis. However, if maintenance is only conducted once per year, it is optimally performed before the winter to ensure pipe inlet is not clogged with sand and debris.

The accumulated sediment, leaves, and debris are to be removed and disposed of in an approved manner and in such a way as to not cause harm to the environment.

Sediment Forebay and Infiltration Basin						
Maintenance Record						
Location (Road Name)	Date	Condition of BMP	Maintenance Performed, Material Removed	Maintenance Personnel	Volume of Sediment Removed (cf)	Comments

Deep Sump Catch Basins and Off-Line Infiltration Structures		
Procedure	**Objective**	**Frequency**
Surface Inspection	Remove sediment and debris from the surface grate to prevent street flooding.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years inspections.
Deep-Sump Catch Basin Interior Sump Sediment Removal	Remove sediment and debris from deep-sump catch basin to prevent it from entering off-line infiltration structure and prohibiting outflow a discharge pipe.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections. (minimum annually)
Off-Line Infiltration Structure Sediment Removal	Maintain infiltration capacity. Inspect and remove sediment and debris to prevent clogging of perforations.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years inspections. (minimum annually)
Outlet Hood Inspections	Visually inspect condition of outlet hood (i.e. cracks, missing bolts, and debris.) If debris is present, remove and discard.	Annually
Pipe Inspection	Remove accumulated sediment to maintain flow capacity through inlet and outlet pipes.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections.

Locations: Whitehall Road

Notes:
Deep sump catch basins and off-line infiltration structures should be maintained at a minimum on a yearly basis. However, if maintenance is only conducted once per year, it is optimally performed after winter sanding has terminated.

The accumulated sediment, leaves, and debris are to be removed and disposed of in an approved manner and in such a way as to not cause harm to the environment.

Deep Sump Catch Basins and Off-Line Infiltration Structures						
Maintenance Record						
Location (Road Name)	Date	Condition of BMP	Maintenance Performed, Material Removed	Maintenance Personnel	Volume of Sediment Removed (cf)	Comments

Sediment Forebay		
Procedure	**Objective**	**Frequency**
Sediment Removal	Remove sediment >2" from the forebay to prevent it from entering the drainage swale.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections. After first year, performed inspection on the same routine maintenance schedule for City catch basin cleaning.
Structural Inspection	Visually inspect slope of bank and check for soil erosion. Visually inspect forebay stones side slopes to make sure they are not being undermined or displaced. Regrade or replace stone as necessary.	Performed quarterly for the first year and after heavy storms. After first year, performed inspection on the same routine maintenance schedule for City catch basin cleaning. Do not allow sediment build up to 6 inches.
Debris and Litter Removal	Remove for aesthetics and contribution of downstream floatables problem.	Perform quarterly or following the first 2 significant storm events (>.25") for the first year. Establish a specific schedule based on first year accumulations (min. 1 year frequency).
Vegetation Removal	Visually inspect the forebay for excessive vegetation growth accumulating in stone voids. Prune plants and remove weeds as needed to maintain flow and infiltration.	Spring and Fall or as necessary. Performed inspection on the same routine maintenance schedule for City catch basin cleaning.

Locations: Cynthia Drive

Notes:
Forebay should be maintained at a minimum on a yearly basis. However, if maintenance is only conducted once per year, it is optimally performed before the winter to ensure pipe inlet is not clogged with sand and debris.

The accumulated sediment, leaves, and debris are to be removed and disposed of in an approved manner and in such a way as to not cause harm to the environment.

Sediment Forebay						
Maintenance Record						
Location (Road Name)	Date	Condition of BMP	Maintenance Performed, Material Removed	Maintenance Personnel	Volume of Sediment Removed (cf)	Comments

Terraced Drainage Swale and Check Dam		
Procedure	**Objective**	**Frequency**
Debris and Litter Removal	Remove litter and debris from the terraced swale and check dam and sediment trap to prevent it from Remove for aesthetics and contribution of downstream floatables.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections.
Sediment Removal	Remove sediment >2" from the swale and check dams to prevent it from entering the outlet structure and inhibiting BMP capacity.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections.
Erosion and Vegetation	Minimize erosion and channelization of stormwater. Inspect swale for signs of scouring, particularly near high velocity areas. Regrade as needed and replace vegetation as needed to maintain 75% coverage.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years inspections.
Outlet Structure Surface Inspection	Remove sediment and debris from the surface grate to prevent street flooding.	Performed quarterly for the first year and after heavy storms. Performed inspection on the same routine maintenance schedule for City catch basin cleaning after first year.
Outlet Structure Interior Sump Sediment Removal	Remove sediment and debris from to prevent it from entering discharge pipe.	Performed quarterly for the first year and after heavy storms. Performed inspection on the same routine maintenance schedule for City catch basin cleaning after first year.

Locations: Cynthia Drive

Notes:
Terraced drainage swale and check dams should be maintained at a minimum on a yearly basis. However, if maintenance is only conducted once per year, it is optimally performed before the winter to ensure pipe inlet is not clogged with sand and debris.

The accumulated sediment, leaves, and debris are to be removed and disposed of in an approved manner and in such a way as to not cause harm to the environment.

Terraced Drainage Swale and Check Dam						
Maintenance Record						
Location (Road Name)	Date	Condition of BMP	Maintenance Performed, Material Removed	Maintenance Personnel	Volume of Sediment Removed (cf)	Comments

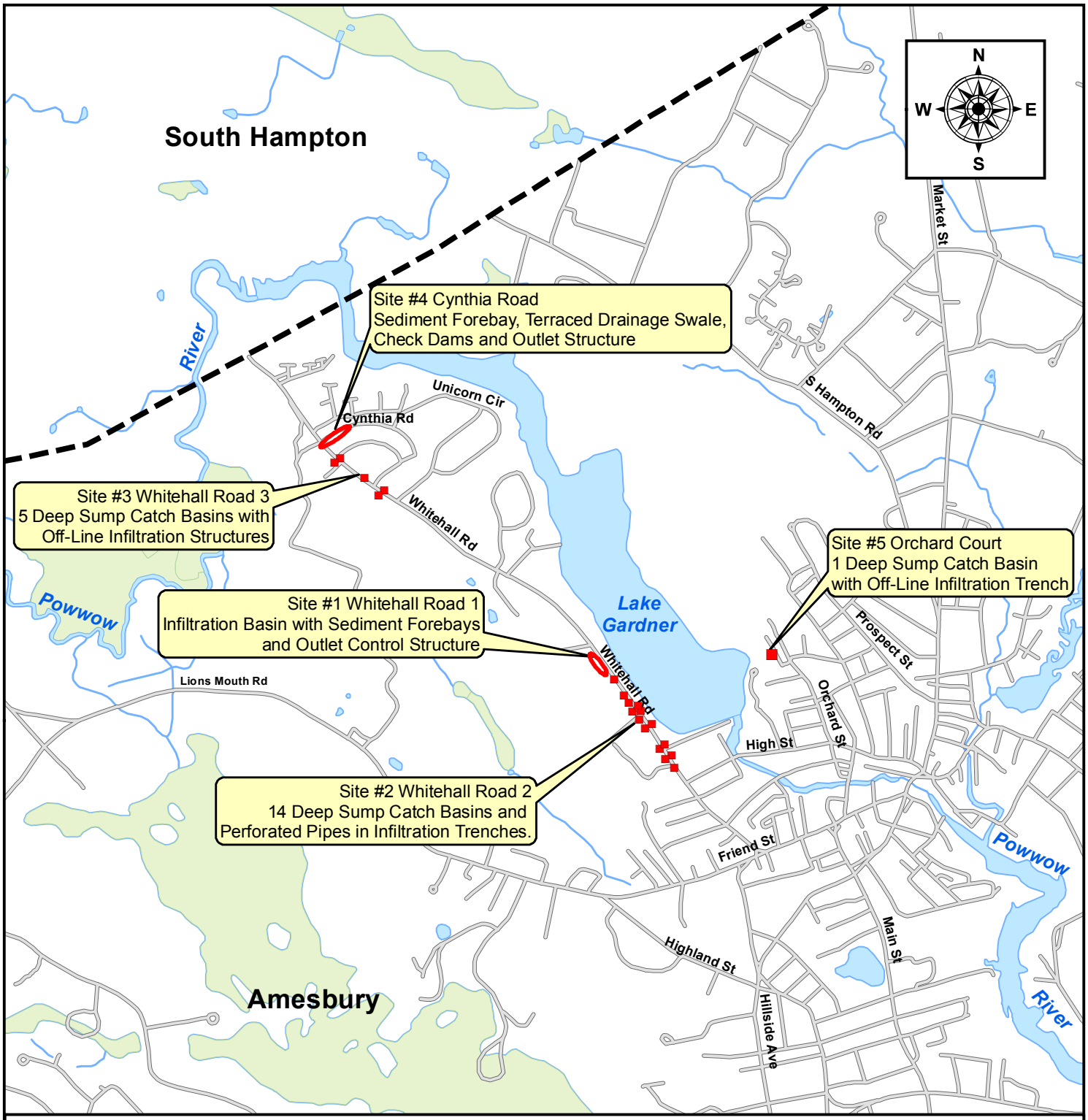
Deep Sump Catch Basins and Off-Line Infiltration Trench		
Procedure	**Objective**	**Frequency**
Surface Inspection	Remove sediment and debris from the surface grate to prevent street flooding.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years inspections.
Deep-Sump Catch Basin Interior Sump Sediment Removal	Remove sediment and debris from deep-sump catch basin to prevent it from entering off-line infiltration structure and prohibiting outflow a discharge pipe.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years capacity inspections. (minimum annually)
Off-Line Infiltration Structure Sediment Removal	Maintain infiltration capacity. Inspect and remove sediment and debris to prevent clogging of perforations.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years inspections. (minimum annually)
Outlet Hood Inspections	Visually inspect condition of outlet hood (i.e. cracks, missing bolts, and debris.) If debris is present, remove and discard.	Annually
Perforated Pipe Inspection	Maintain infiltration capacity of the perforated pipe and off-line infiltration trench. Inspect and remove sediment and debris to prevent clogging of perforatted pipe.	Performed quarterly for the first year and after heavy storms. Establish a specific schedule based on previous years inspections.
Perforated Pipe Flushing	Maintain infiltration capacity of the perforated pipe and off-line infiltration trench. Inspect and flush perforated pipe with water jet to remove sediment accumulation.	Establish a specific schedule based on previous years inspections.

Locations: Orchard Court

Notes:
Deep sump catch basins and off-line infiltration trench should be maintained at a minimum on a yearly basis. However, if maintenance is only conducted once per year, it is optimally performed after winter sanding has terminated.

The accumulated sediment, leaves, and debris are to be removed and disposed of in an approved manner and in such a way as to not cause harm to the environment.

Deep Sump Catch Basins and Off-Line Infiltration Trench						
Maintenance Record						
Location (Road Name)	Date	Condition of BMP	Maintenance Performed, Material Removed	Maintenance Personnel	Volume of Sediment Removed (cf)	Comments



Legend

- Deep Sump Catch Basin
- Infiltration Basin/Terraced Swale

Hydrography

- Surface Water
- Wetland Area
- Stream, Brook
- Town/State Boundary

0 1,000 2,000 3,000 Feet

Lake Gardner
Water Quality Improvements

Stormwater BMP Locations

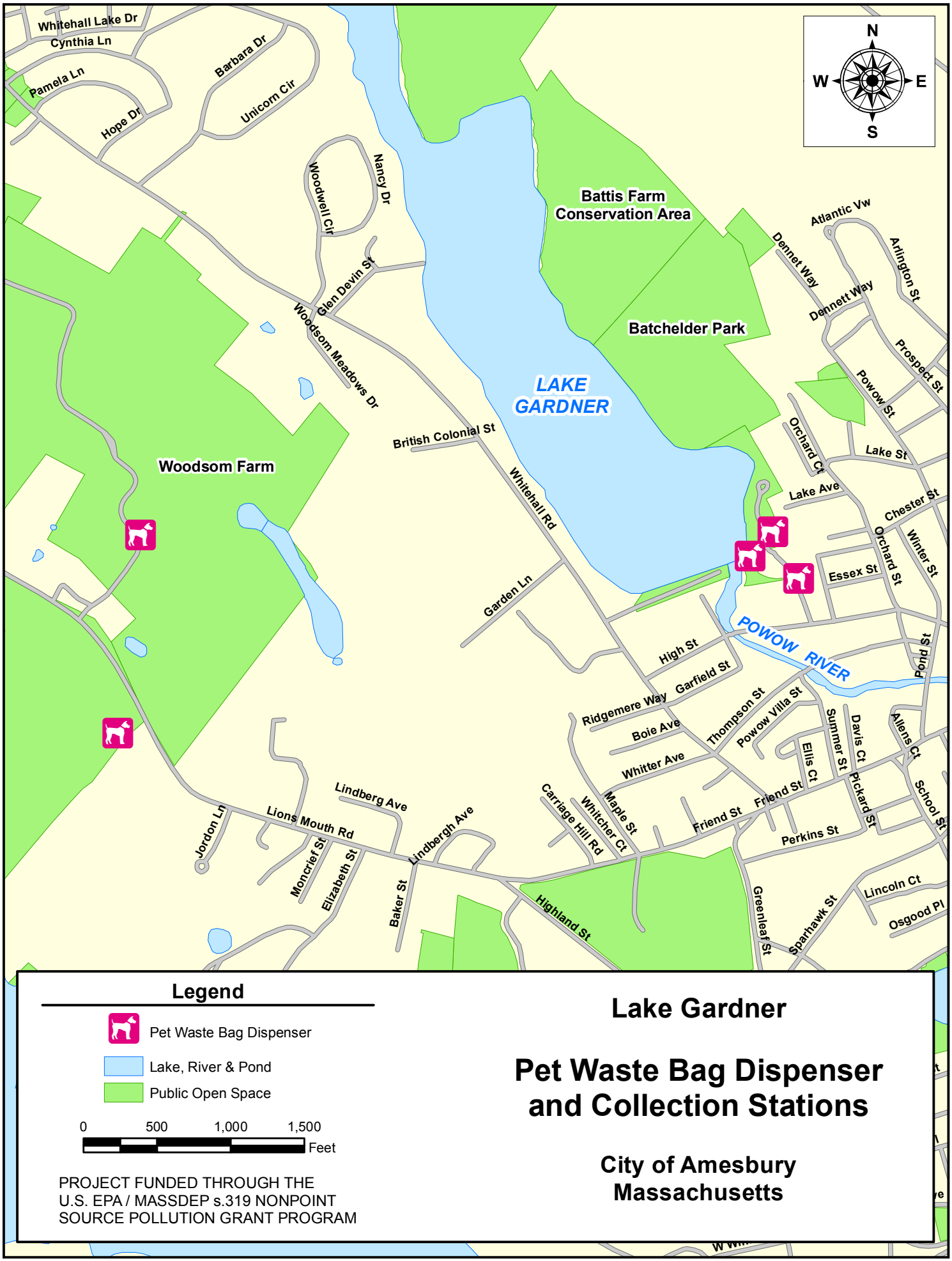
City of Amesbury
Department of Public Works

Comprehensive Environmental Inc.

Task 4 Deliverables

Pet Waste Bag Dispensing Unit

Pet Waste Bag Dispensing Unit



Legend

- Pet Waste Bag Dispenser
- Lake, River & Pond
- Public Open Space

0 500 1,000 1,500 Feet

PROJECT FUNDED THROUGH THE
U.S. EPA / MASSDEP s.319 NONPOINT
SOURCE POLLUTION GRANT PROGRAM

Lake Gardner

Pet Waste Bag Dispenser and Collection Stations

City of Amesbury
Massachusetts

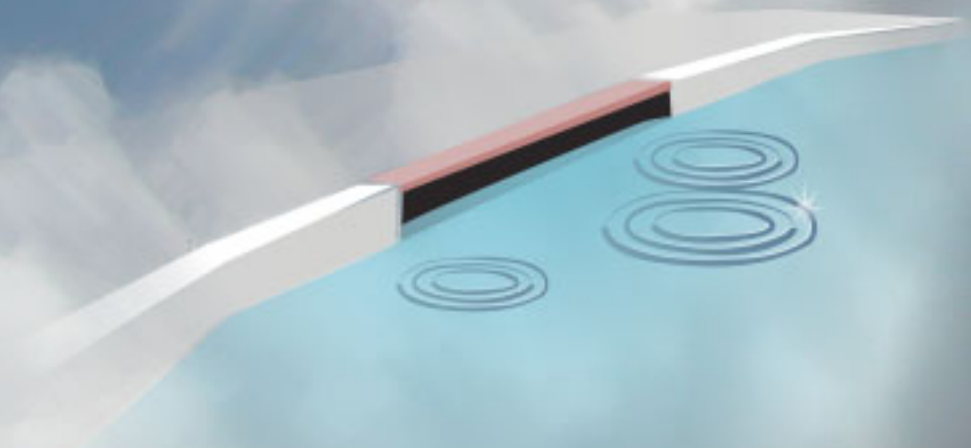
Task 5 Deliverables

Literature Display

Literature Display

WHEN IT RAINS IT DRAINS

After the Storm



For more information contact:

Amesbury Department of Public Works

978-388-8116

or visit
www.epa.gov/npdes/stormwater
www.epa.gov/nps

EPA United States Environmental Protection Agency

EPA 833-B-03-002

January 2003

THE YEAR OF CLEAN WATER
Celebration & Recommitment

A Citizen's Guide to Understanding Stormwater

WHEN IT RAINS IT DRAINS

What is stormwater runoff?

Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?

Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.

- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.
- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.

Stormwater Pollution Solutions

Residential

Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.

Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

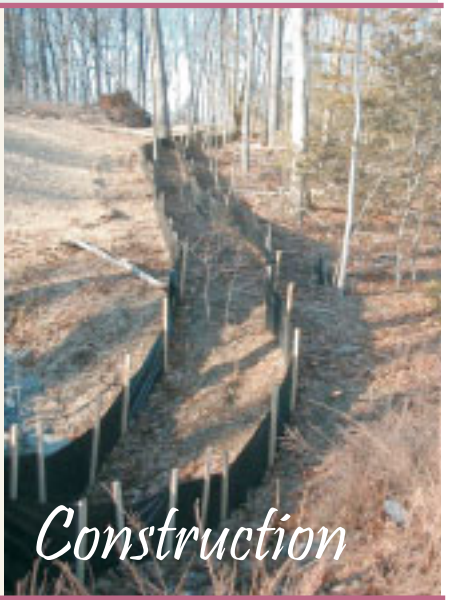
Commercial

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

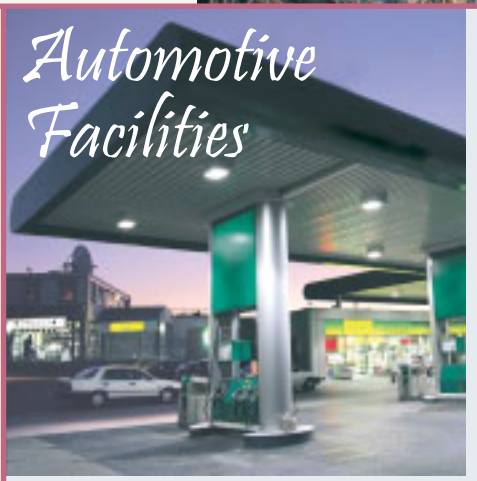


Construction

Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.



Automotive Facilities

Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.

How can you help?

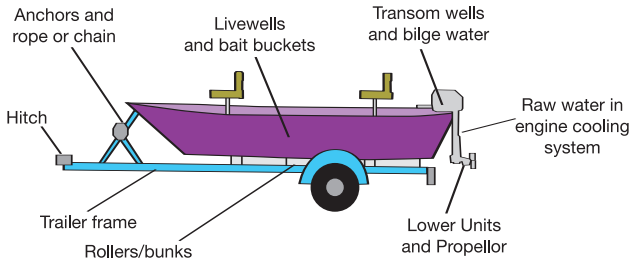
Michelle Robinson DCR

- Remove all plants and animals from your boat motor, trailer, anchors, fishing gear, and dive gear and dispose of them on dry land, well away from the water or in a trash can.
- Flush engines and dispose of livewell, bait bucket, and cooling water away from the shore after each use.
- Never release any plant or animal into a body of water unless it came out of that body of water.
- Never empty aquariums into a waterbody.
- Inspect and wash your boat, preferably with hot water, and allow it to completely dry before entering another body of water.
- Request a free sign for your boat ramp.
- Familiarize yourself with invasive species by requesting one of our free guides.
- Join the Massachusetts Weed Watchers Program and help identify and report new infestations.

DCR Lakes and Ponds Program
251 Causeway Street, Suite 600
Boston, MA 02114
617-626-1411
www.mass.gov/lakesandponds

Remember:

Always remove all plant and animal fragments from your boat, trailer and gear. Dispose of livewell, bait bucket, and cooling water well away from the shore.



redrawn from Iowa DNR

Ladd Johnson (NOAA)

Aquatic plants caught on boat trailer.

STOP AQUATIC HITCHHIKERS!

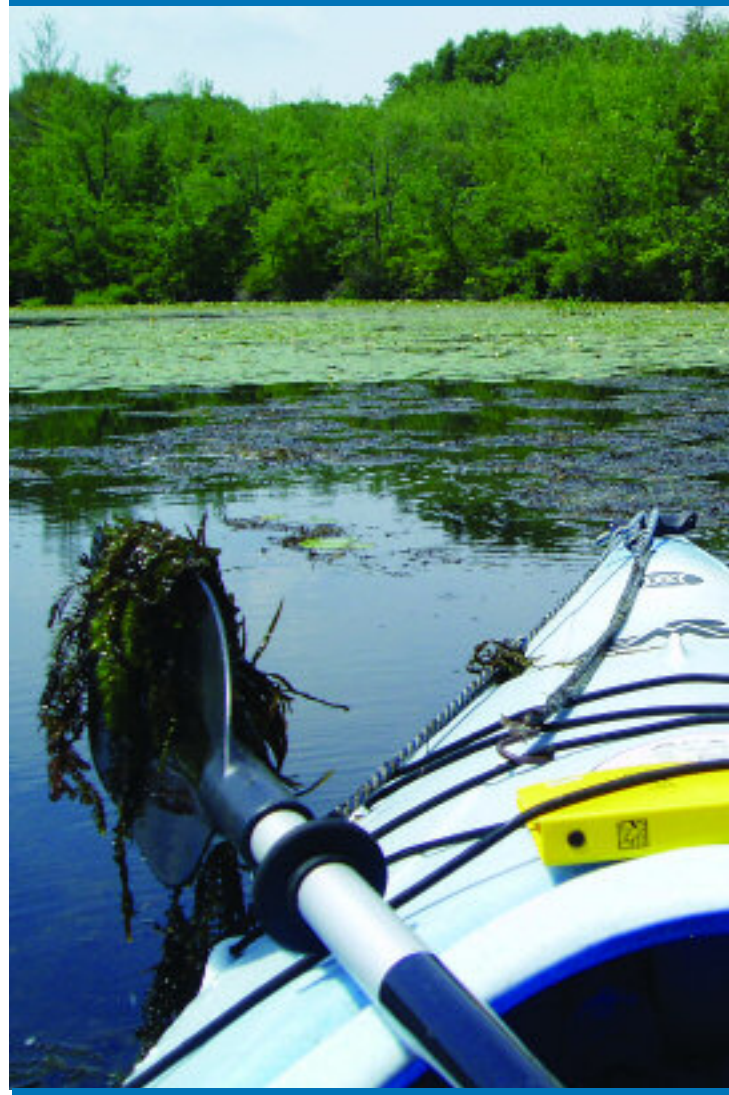
Prevent the transport of nuisance species.
Clean all recreational equipment.
www.ProtectYourWaters.net

To prevent the spread of Didymo (an invasive algae) and other invasive organisms, check, clean and dry all gear. Soak felt soled waders in hot soapy water for 30 minutes and allow to completely dry.

Printed 2008

dcr Massachusetts

Lakes and Ponds Program



Prevent the spread of invasive species

ATTENTION BOATERS!

What are invasive species?

Our lakes contain a wide variety of native plants and animals that are essential to a healthy lake ecosystem. These native species originated here in New England and are well adapted to our climate and to the other species that live here. However, many "non-native" or "exotic" species have been brought here from other parts of the country and the world. Some of these species are considered "invasive" because they are able to dominate or significantly alter an area's ecology. Once established, they continue to spread to additional locations by hitching rides on boats, trailers, gear, and in bait buckets.

When invasive species enter a water body, they can have a devastating impact. Since the local ecosystem has not developed natural controls (animals or other plants to limit their growth) invasive species may spread rapidly.

Wakulla Spring, FL, before hydrilla.

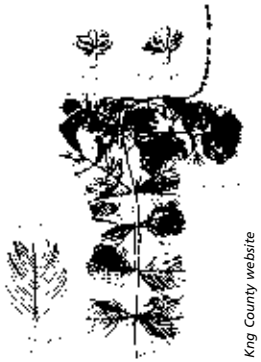
Wakulla Spring, FL, after hydrilla.

Why are they harmful?

- Many invasive plants form dense mats of vegetation that can restrict boating, fishing, and swimming, and make the waterway entirely impassable.
- Many native plants and animals cannot compete for space or food with exotic species, and are crowded out or eliminated from the area.
- The aesthetic appeal, recreational value, and surrounding property values may quickly decline as the invasive species take over.
- The microscopic larval stage of Zebra Mussel and Asian Clam can easily travel undetected in bilge, bait, and livewell water. They can proliferate at an alarming rate and frequently destroy boat motors, buoys, and fishing gear. Their razor sharp shells often create a hazard for beach visitors.
- Once invasive plants and animals are established, they are almost impossible to eradicate.

Invasive Plants and Animals

A few of the invasive species to watch for...

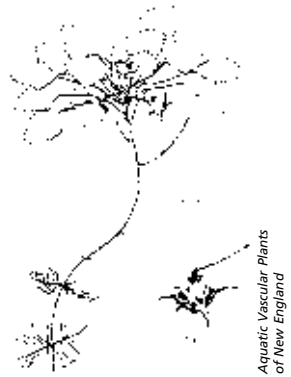


Kng County website

Eurasian Milfoil

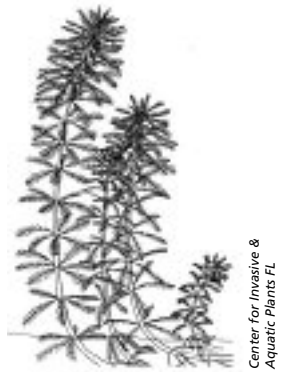
Maine DEP

Variable Milfoil



Aquatic Vascular Plants of New England

Water Chestnut



Center for Invasive & Aquatic Plants FL

Parrot Feather

Kng County website

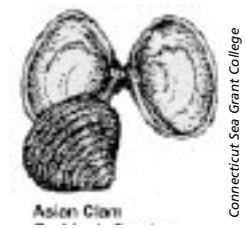
Fanwort

Center for Invasive & Aquatic Plants FL

Curly-leaved Pondweed

Charles Ramcharan, Wisconsin Sea Grant

Zebra Mussel

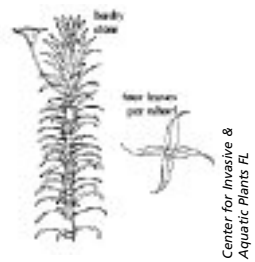


Connecticut Sea Grant College

Asian Clam

Center for Invasive & Aquatic Plants FL

Hydrilla



Center for Invasive & Aquatic Plants FL

South American Waterweed

Snakehead Fish

If you think you have caught a Snakehead do not put it back in the water. Please freeze the fish and contact the DCR Lakes and Ponds program immediately.

Save money and avoid the problem of disposing unneeded or unused household hazardous waste!

Consider reducing your purchase of products that contain hazardous ingredients. Learn about the use of alternate methods or products without hazardous ingredients for some household needs. Some household cleaner recipes can be found at **www.ecocycle.org/hazwaste/recipes.cfm**

If the use of hazardous substances cannot be avoided, please follow these tips to avoid any possible risks:

- Use and store products carefully.
- Keep in original containers and do not remove labels. Never store in food containers.
- Never mix leftovers with other products. Incompatible products might react, ignite or explode.
- Follow any instructions for use and disposal provided on product labels.

What is Household Stormwater Pollution?

Household stormwater pollution happens when contaminants from our homes and cars go down the storm drain. This can happen through illegal dumping into storm drains, or more commonly, when rainwater washes pollutants and other debris from our yards and driveways to the storm drain and into our streams, lakes, and wetlands. Common sources of household pollution are motor oil and antifreeze left on driveways, soapy water from car washing, fertilizers and pesticides in lawns and pet waste left in yards.

What You Can Do

You can protect our water quality by following the simple, but effective, steps outlined in this brochure.

It's Up to You!

Your actions make a difference! You have a direct impact on the health of our streams, lakes, ponds, ground-water, and reservoirs.

Wachusett Reservoir Watershed
Department of Conservation and Recreation
Division of Water Supply Protection
180 Beaman Street
West Boylston, MA 01583
(508) 792-7806
www.mass.gov/dcr/watersupply.htm
March 2011. This brochure has been modified and used with permission from the City of Bonney Lake, WA.

dcr
Massachusetts

Household Stormwater Pollution Prevention

Practical steps to stop pollution from entering storm drains in the Wachusett Reservoir watershed that flow untreated to lakes, streams, wetlands, and reservoirs.

Around the House

Properly dispose of household chemicals. Never wash or pour chemicals, cleaners, or solvents into the storm drain, or down any drains in your home. It is toxic to aquatic life and it is also illegal. Take antifreeze, solvents, gas, brake fluid, and other hazardous substances to an approved disposal location.

Residents of Boylston, Holden, Paxton, Princeton, Rutland, Sterling, and West Boylston can take household oil-based paint and chemicals to the **Wachusett Regional Recycling Center *Household Paint and Chemical Collection*** event held four times a year at the facility in West Boylston. Check **www.wachusettearthday.org** or local newspapers for collection dates, fees, and directions.

Some of the materials accepted include: paint thinners, varnishes, solvents, strippers, pesticides, herbicides, kerosene, gasoline, swimming pool chemicals, aerosols, photo chemicals, chemistry sets, oven and drain cleaners, motor oil, and antifreeze. Contact Wachusett Earthday for a complete list of accepted items.

Sweep your driveway. Sweep up debris instead of hosing off or pressure washing your driveway. Not only is the sediment harmful, but there can also be residue from vehicles on the driveway.

Working on Vehicles

Wash your car on a lawn or at a licensed facility. Car wash water contains dirt, road grime, heavy metals, oils and soaps that are toxic to fish and aquatic life. Sending soap runoff down the driveway and into a storm drain is not only harmful to the environment; it could be a violation of local, state and/or federal laws.

Maintain your vehicle. The liquids from leaky cars are harmful to aquatic life and are washed directly into the storm drain every time it rains. Test to see if your vehicle is leaking by placing clean cardboard on the ground under your engine and checking it the next day. Repair all leaks as soon as they are discovered.

Properly dispose of oil and other auto waste at an approved waste facility. Don't pour liquids down the drain.

Clean up Spills. Use kitty litter, sawdust, or commercial absorbent pads to dry up any spilled liquid, then sweep it up and place it in the garbage. Don't wash it into the street or storm drain.

In the Lawn & Garden

Pick up after your pets. Rainwater can wash bacteria and parasites from pet waste into the storm drain, which flows untreated into our natural waterways.

Use organic, time-release fertilizers. These fertilizers slowly release nutrients to your lawn, reducing the amount of pollutants washed into our waterways.

Avoid pesticides and herbicides when possible. Not only is it better for the health of our lakes and streams, but it is also better for the health of your family. If you must use pesticides, use them sparingly and only where needed to ensure excess will not be washed into the storm drain. Always follow the label directions.

Dispose of yard waste properly. Compost yard debris or have it hauled away. Yard debris can release excess nutrients, which promotes algae growth in waterways.

Use a mulching mower. You can decrease your use of fertilizers by 25 percent by using a mulching lawnmower.

Around the Neighborhood

Pick up litter. Clean up any trash to reduce the chance of litter or contaminants entering the stormwater system.

Report pollution. It is illegal to dump chemicals or other materials in the storm drain. If you notice illegal dumping, or see, hear about, or even suspect activity that you believe is against the law and placing people's health or natural resources at risk, contact the MA Environmental Strike Force at: 1-888-VIOLATE (1-888-846-5283).

Educate neighbors. Share the importance of adopting stormwater pollution prevention practices with your neighbors.

What's the Problem With Pet Waste?

Pet waste left in yards and communities' streets can have many adverse effects on the environment, as it is full of harmful bacteria and excess nutrients.

Besides the fact pet waste is a neighborhood nuisance, it can make people sick, especially children who are more likely to come into contact with it while playing. Pet waste left on lawns can also kill or damage grass and other plants.

When pet waste is washed into lakes or streams, the waste decays, uses up oxygen, and sometimes releases ammonia. This can kill fish. It also contains nutrients that encourage weed and algae growth.

Water with too many nutrients becomes cloudy and green… imagine this in your backyard pond or stream!

Managing pet waste properly is something easy that everyone can do to make a difference in the quality of our surface waters.

What goes in here …

… comes out here.

Rainfall and snowmelt in the Wachusett Reservoir watershed goes directly into streams, rivers, and lakes untreated through the storm drain system. Along the way, it picks up contaminants on its path. That's why it is so important to make sure that pollutants such as pet waste do not end up in storm drains.

WACHUSETT RESERVOIR WATERSHED
Department of Conservation and Recreation
180 Beaman Street
West Boylston, MA. 01583
508-792-7806
www.mass.gov/dcr/watershed

March 2015

dcr
Massachusetts

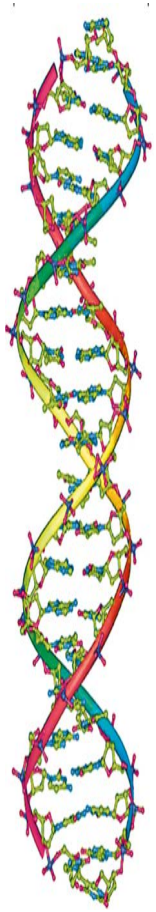
DOG WASTE AND SURFACE WATER QUALITY

Every dog produces about ¾ lbs. of solid waste per day… and about 7.8 billion fecal coliform bacteria.

When pet waste is left on the ground, rain or snowmelt carries the bacteria into surface waters, either directly or through the storm drain system, and eventually to drinking water supplies.

Microbial Source Tracking (MST)

Microbial Source Tracking is a set of techniques used to determine sources of fecal indicator bacteria in the environment. MST tests attempt to determine whether fecal bacteria are being introduced into water bodies through human, wildlife, or domestic animal sources.



DCR Division of Water Supply Protection has performed MST tests on several streams that flow to the Wachusett Reservoir. Initial results indicate that dogs are a major contributor of bacteria to these waters. **We need your help** to eliminate bacteria by picking up after your pet in your yard and while on walks.

Why Aren't Dogs Allowed On DCR Watershed Lands?*

DCR's watershed lands serve as protection for the Wachusett Reservoir, a sensitive drinking water supply for 2.5 million Massachusetts residents.

Bacteria and other parasites, such as *Giardia* and *Cryptosporidium*, found in pet waste can survive for long periods when left on the ground. These can then get washed into the drinking water supply during the next storm, compromising water quality, which is regulated by state and federal laws.

***Dogs are ONLY ALLOWED on the portion of the Oakdale Rail Trail not owned by DCR (Thomas Street to the I-190 overpass).**

Please pick up after your pet and DO NOT throw bagged waste into the woods!

How you can help

- **BRING IT** - Always bring a plastic bag when you walk your dog.
- **BAG IT** - Use the bag as a glove to pick up the pet waste. Scoop up the waste and turn the bag inside out around the waste.
- **DISPOSE IT** – Properly dispose the waste by placing it in a trash can or flushing it unbagged down the toilet. ***NEVER THROW WASTE DOWN A STORM DRAIN!***
- **WASH YOUR HANDS.**
- **PICK UP** after your pet in your yard.
- **BRING** your dog only where dogs are allowed.

The Massachusetts Legislature passed *An Act Relative to the Regulation of Plant Nutrients* in 2012. This law directed the Massachusetts Department of Agricultural Resources (MDAR) to develop regulations that ensure plant nutrients are applied in an effective manner for maintaining healthy lands while minimizing the impacts of the nutrients on surface and ground water resources, thus protecting human health and the environment.

The regulations, 330 CMR 31.00, impact anyone who applies plant nutrient materials to both agricultural and non-agricultural land, including lawn and turf. ***These regulations apply to individual homeowners***.

Details about the law are available at www.mass.gov/eea/docs/agr/pesticides/docs/plant-nutrient-regs-turf-and-lawns-factsheet.pdf.

Streams, rivers, wetlands and ponds within the Wachusett Reservoir Watershed ultimately flow to the Wachusett Reservoir, a drinking water supply for 2.5 million Massachusetts residents. Storm drains within the watershed flow untreated to nearby surface waters – and therefore to the reservoir.

Towns and individuals within the watershed also rely on the watershed's high quality ground water as a source of drinking water.

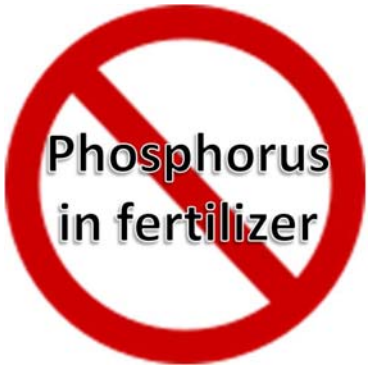
Following these newly enacted fertilizer regulations will help to reduce the chance of an over-abundance of nutrients from impacting surface and ground waters. The law will help provide high quality water for drinking and recreation.

Please pick up after your pets, as pet waste is also a source of nutrients.

Wachusett Reservoir Watershed
Department of Conservation and Recreation
Division of Water Supply Protection
180 Beaman Street
West Boylston, MA 01583
508-792-7806
www.mass.gov/dcr/watershed

November 2015

dcr Massachusetts



New laws in Massachusetts restrict the use of fertilizers containing Phosphorus on all non-agricultural turf and lawns in order to protect water resources

Algae bloom

Nutrient pollution, a form of water pollution, refers to contamination by excessive inputs of nutrients such as Nitrogen and Phosphorus.

The major sources of nutrients to streams and groundwater are precipitation, dissolution of natural minerals from soil or geologic formations, ***fertilizer application***, and effluent from sewage-treatment plants. Nutrients can also come from faulty septic systems and animal waste (so please pick up after your pets).

Stormwater – water from rain or snow storms – carries these nutrients directly into surface waters, or into storm drains which empty into nearby streams, lakes or wetlands.

Although Nitrogen and Phosphorus are natural parts of aquatic ecosystems, they can act as fertilizer, causing excessive growth of algae and weeds, when there is an abundance in surface waters.

Algae are relative short lived; when they decay, algae consumes the available oxygen in the water. This can lead to a die-off of fish and animals, cause water bodies to become cloudy and odorous, and limit recreational activities.

Some specific restrictions and requirements for use of nutrient application on turf and lawns:

- Phosphorus-containing fertilizer may only be applied when a soil test indicates that it is needed or when a lawn is being established, patched, or renovated.
- Do not apply plant nutrient materials to sidewalks or other impervious surfaces. Any material that lands on these surfaces must be swept back onto the grass or cleaned up.
- No applications of plant nutrients shall be made between December 1 and March 1, to frozen and/or snow covered soil, to saturated soil, or soils that frequently flood, within 20 feet of waterways if using a broadcast method, or 10 feet if using a more targeted application, within a Zone I of a public water supply well or within 100 feet of surface waters that are used for public drinking water supply.
- Plant nutrient amounts that may be applied shall not exceed UMass Guidelines for plant nutrient application rates to turf.
- Soil tests for nutrient analysis shall be obtained from UMass Extension Soil Testing Lab or a laboratory using methods and procedures recommended by UMass. A soil test is valid for three years.

Websites

www.mass.gov/eea/docs/agr/pesticides/docs/plant-nutrient-regulations.pdf. *A complete list of the restrictions and text of the regulations*

http://ag.umass.edu/turf/publications-resources/nutrient-management-information. *UMass turf guidelines.*

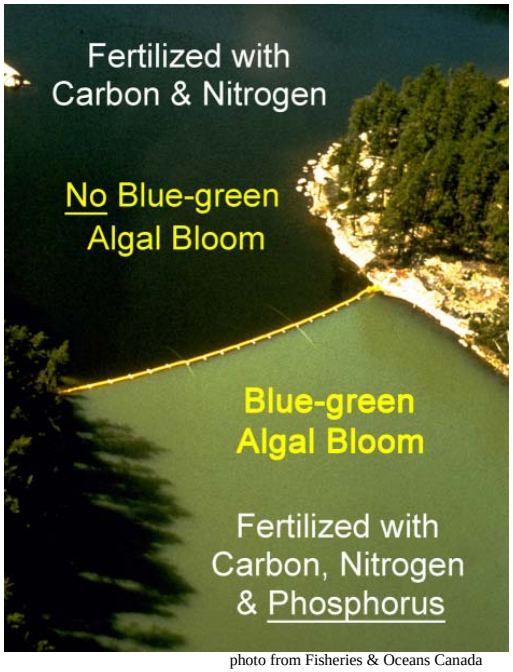


photo from Fisheries & Oceans Canada

The International Institute for Sustainable Development Experimental Lakes Area is one of the world's most influential freshwater research facilities. It features a collection of 58 small lakes and their watersheds in Northwestern Ontario, Canada.

The picture above shows the results of a decades long study that demonstrates the negative effects of yearly phosphorus addition to a freshwater system.

More information available at www.iisd.org/ela.

Too many nutrients in surface waters can result in algal blooms, which can be toxic to humans and animals.

Clean Water

Everybody's Business

10 Things You Can Do to Prevent Stormwater Runoff Pollution

- Use fertilizers sparingly and sweep up driveways, sidewalks, and gutters
- Never dump anything down storm drains or in streams
- Vegetate bare spots in your yard
- Compost your yard waste
- Use least toxic pesticides, follow labels, and learn how to prevent pest problems
- Direct downspouts away from paved surfaces; consider starting a rain garden
- Take your car to the car wash instead of washing it in the driveway
- Check your car for leaks and recycle your motor oil
- Pick up after your pet
- Have your septic tank pumped and system inspected regularly

EPA United States Environmental Protection Agency

For more information, visit www.epa.gov/nps or www.epa.gov/npdes/stormwater

How to Create a Rain Garden

Designing and planting a rain garden is much like creating any other perennial garden, with a few unique differences.

- The garden must be located where runoff can be diverted into it, at least 10 feet away from building foundations and septic systems.
- A shallow, saucer-shaped depression is created in the garden to hold rain as it soaks in. The garden should be about 20-30% of the area from which it is receiving runoff.
- Soil replacement and additional preparations are sometimes needed for success. A good soil mix for rain gardens is 50-60% sand, 20-30% topsoil, and 20-30% compost.
- Species of perennial plants and shrubs native to our region are recommended, as they are adapted to local conditions and will not need extra care once they are established. Plant flood tolerant species in the center and drought tolerant ones around the edges. Berry-bearing and nectar-producing plants attract and nourish wildlife.
- A mulch of shredded hardwood is an integral part of your rain garden. It keeps the soil moist and ready to soak up rain, and makes your garden low-maintenance.

Did You Know? *The average home roof is 1,300 square feet and generates 832 gallons of runoff during a single 1" rainfall event.*

Rain Garden Resources

New England Wildflower Society:
http://www.newfs.org/publications-and-resources/rain-gardens.html

URI Healthy Landscapes:
www.uri.edu/ce/healthylandscapes/raingarden.htm

University of Connecticut Extension Service:
www.sustainability.ucon.edu/pdf/raingardenbroch.pdf

Natural Resources Conservation Service:
www.ia.nrcs.usda.gov/features/raingardens.html

Going Green with Storm Water:
Rain Gardens

Mass Audubon
Protecting the Nature of Massachusetts

Broad Meadow Brook Conservation Center
And Wildlife Sanctuary
414 Massasoit Road
Worcester, MA 01604

Phone: 508-753-6087
Fax: 508-755-0148
www.massaudubon.org

This brochure is partially funded by an EPA
Healthy Communities Grant

Going Green with Storm Water

Rain Gardens

A Best Management Practice to:

- Reduce Stormwater Runoff
- Improve Water Quality
- Enhance Your Landscape

Make your own beautiful contribution to cleaner water in the Blackstone River Watershed.

Come visit Broad Meadow Brook's Demonstration Rain Garden

Mass Audubon
Protecting the Nature of Massachusetts

What is a Rain Garden?

A rain garden is a shallow depression planted with perennial native plants that are tolerant of both dry and wet conditions. Rain gardens capture runoff from impervious surface areas such as rooftops and driveways and allow it to seep slowly into the ground. Most importantly, rain gardens help preserve nearby streams and ponds by reducing the amount of polluted runoff and filtering pollutants.

Why Plant a Rain Garden?

Stormwater runoff from residential areas often contains excess lawn and garden fertilizers, pesticides and herbicides, oil, yard wastes, sediment and animal wastes which cause water pollution.

Rain gardens fill with stormwater and allow the water to slowly filter into the ground rather than running off into storm drains, and eventually into streams and lakes.

Rain gardens reduce peak storm flows, helping to prevent stream bank erosion and lowering the risk for local flooding.

By collecting and using rainwater that would otherwise run off your yard, you not only return rain to the water table, but you are also creating a beautiful solution to water pollution.

The Rain Garden at Broad Meadow Brook Conservation Center

The rain garden captures roof runoff from three down spouts, and a rain barrel captures the fourth. We use water from the rain barrel to irrigate when necessary.

We chose a variety of native plants that provide color and interest throughout the growing season. They produce nectar and berries to attract wildlife such as butterflies, hummingbirds, cedar waxwings and winter robins.

Plant List:

Shrubs:

Sweet Pepperbush
Dogwood
Shamrock Inkberry
Winterberry
Gro-Low Sumac
Lowbush Blueberry
Highbush Blueberry
Dwarf Fothergilla
Slender Deutzia
Potentilla

Perennials:

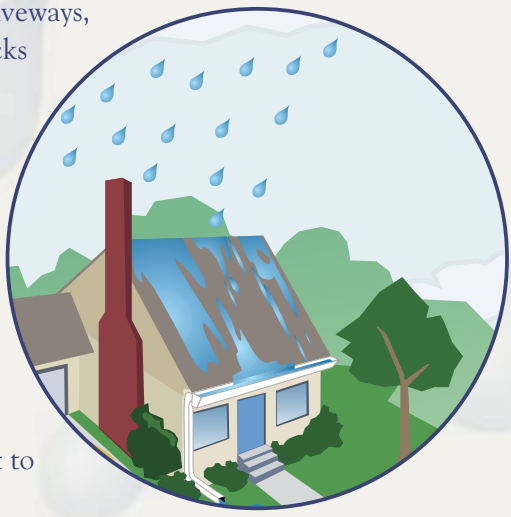
Dwarf Aster
Swamp Milkweed
Joe Pye Weed
Coneflower
Blazing Star
Beebalm
Blackeyed Susan
Crested Iris
Foamflower
Yarrow
Sea Oats

Mass Audubon is a lead partner in the Blackstone River Coalition (BRC) and the **Campaign for a Fishable/ Swimmable Blackstone River by 2015**. All of Worcester's waterways, including Broad Meadow Brook, are headwater tributaries to the Blackstone. To further implement the Campaign, the BRC is targeting polluted runoff and stormwater volume as the major issue impacting water quality.

The BRC's *"Tackling Stormwater in the Blackstone River Watershed"* Initiative is a four-pronged approach focusing on homeowners, municipal decision makers, developers, and businesses. See www.zaptheblackstone.org for details.

Remember that anything that enters a storm drain in the road is discharged untreated into the water bodies we use for swimming, fishing, paddling, and recharging our drinking water supplies. The more we can all do to reduce stormwater impacts to our waterways, the healthier they will be.

As stormwater flows over driveways, lawns, and sidewalks, it picks up debris, chemicals, dirt, and other pollutants. Stormwater can flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water. Polluted runoff is the nation's greatest threat to clean water.



By practicing healthy household habits, homeowners can keep common pollutants like pesticides, pet waste, grass clippings, and automotive fluids off the ground and out of stormwater. Adopt these healthy household habits and help protect lakes, streams, rivers, wetlands, and coastal waters. Remember to share the habits with your neighbors!

Healthy Household Habits for Clean Water

Vehicle and Garage

- Use a commercial car wash or wash your car on a lawn or other unpaved surface to **minimize** the amount of dirty, soapy water flowing into the storm drain and eventually into your local waterbody.

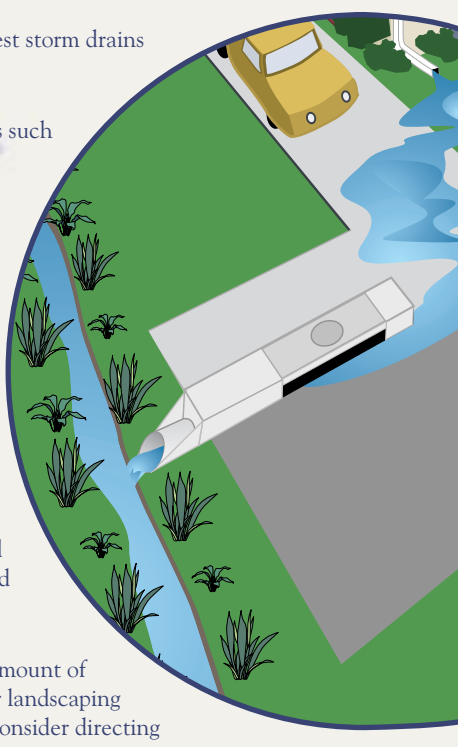
- Check your car, boat, motorcycle, and other machinery and equipment for leaks and spills. Make repairs as soon as possible. Clean up **spilled fluids** with an absorbent material like kitty litter or sand, and don't rinse the spills into a nearby storm drain. Remember to properly dispose of the absorbent material.
- **Recycle** used oil and other automotive fluids at participating service stations. Don't dump these chemicals down the storm drain or dispose of them in your trash.

Lawn and Garden

- Use pesticides and fertilizers **sparingly**. When use is necessary, use these chemicals in the recommended amounts. Avoid application if the forecast calls for rain; otherwise, chemicals will be washed into your local stream.
- Select **native** plants and grasses that are drought- and pest-resistant. Native plants require less water, fertilizer, and pesticides.
- **Sweep up** yard debris, rather than hosing down areas. Compost or recycle yard waste when possible.
- Don't overwater your lawn. Water during the **cool** times of the day, and don't let water run off into the storm drain.
- Cover piles of dirt and mulch being used in landscaping projects to prevent these pollutants from blowing or washing off your yard and into local waterbodies. **Vegetate** bare spots in your yard to prevent soil erosion.

Home Repair and Improvement

- Before beginning an outdoor project, locate the nearest storm drains and **protect** them from debris and other materials.
- **Sweep up** and properly dispose of construction debris such as concrete and mortar.
- Use hazardous substances like paints, solvents, and cleaners in the **smallest amounts possible**, and follow the directions on the label. Clean up spills **immediately**, and dispose of the waste safely. Store substances properly to avoid leaks and spills.
- Purchase and use **nontoxic**, **biodegradable**, **recycled**, and **recyclable** products whenever possible.
- **Clean** paint brushes in a sink, not outdoors. Filter and reuse paint thinner when using oil-based paints. Properly dispose of excess paints through a household hazardous waste collection program, or donate unused paint to local organizations.



- **Reduce** the amount of paved area and increase the amount of vegetated area in your yard. Use native plants in your landscaping to reduce the need for watering during dry periods. Consider directing downspouts away from paved surfaces onto lawns and other measures to increase infiltration and reduce polluted runoff.

Pet Care

- When walking your pet, remember to **pick up** the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Swimming Pool and Spa

- **Drain** your swimming pool only when a test kit does not detect chlorine levels.
- Whenever possible, drain your pool or spa into the **sanitary** sewer system.
- Properly store pool and spa chemicals to **prevent** leaks and spills, preferably in a covered area to avoid exposure to stormwater.

Septic System Use and Maintenance

- Have your septic system **inspected** by a professional at least every 3 years, and have the septic tank **pumped** as necessary (usually every 3 to 5 years).
- Care for the septic system drainfield by **not** driving or parking vehicles on it. Plant only grass over and near the drainfield to avoid damage from roots.
- Flush responsibly. Flushing household chemicals like paint, pesticides, oil, and antifreeze can **destroy** the biological treatment taking place in the system. Other items, such as diapers, paper towels, and cat litter, can **clog** the septic system and potentially damage components.

Storm drains connect to waterbodies!

Internet Address (URL) • HTTP://www.epa.gov

EPA 833-B-03-003
January 2003

THE YEAR OF CLEAN WATER
Celebrate Restoration!

Remember: Only rain down the drain!

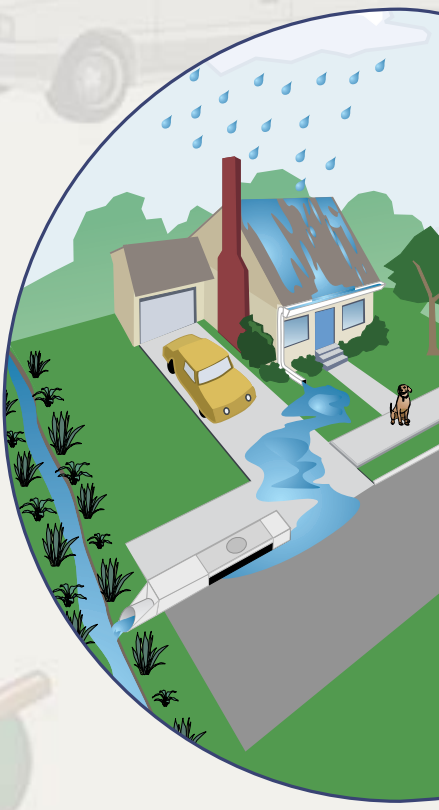
For more information, visit
www.epa.gov/npdes/stormwater
or
www.epa.gov/nps

Make your home

The

SOLUTION TO STORMWATER POLLUTION!

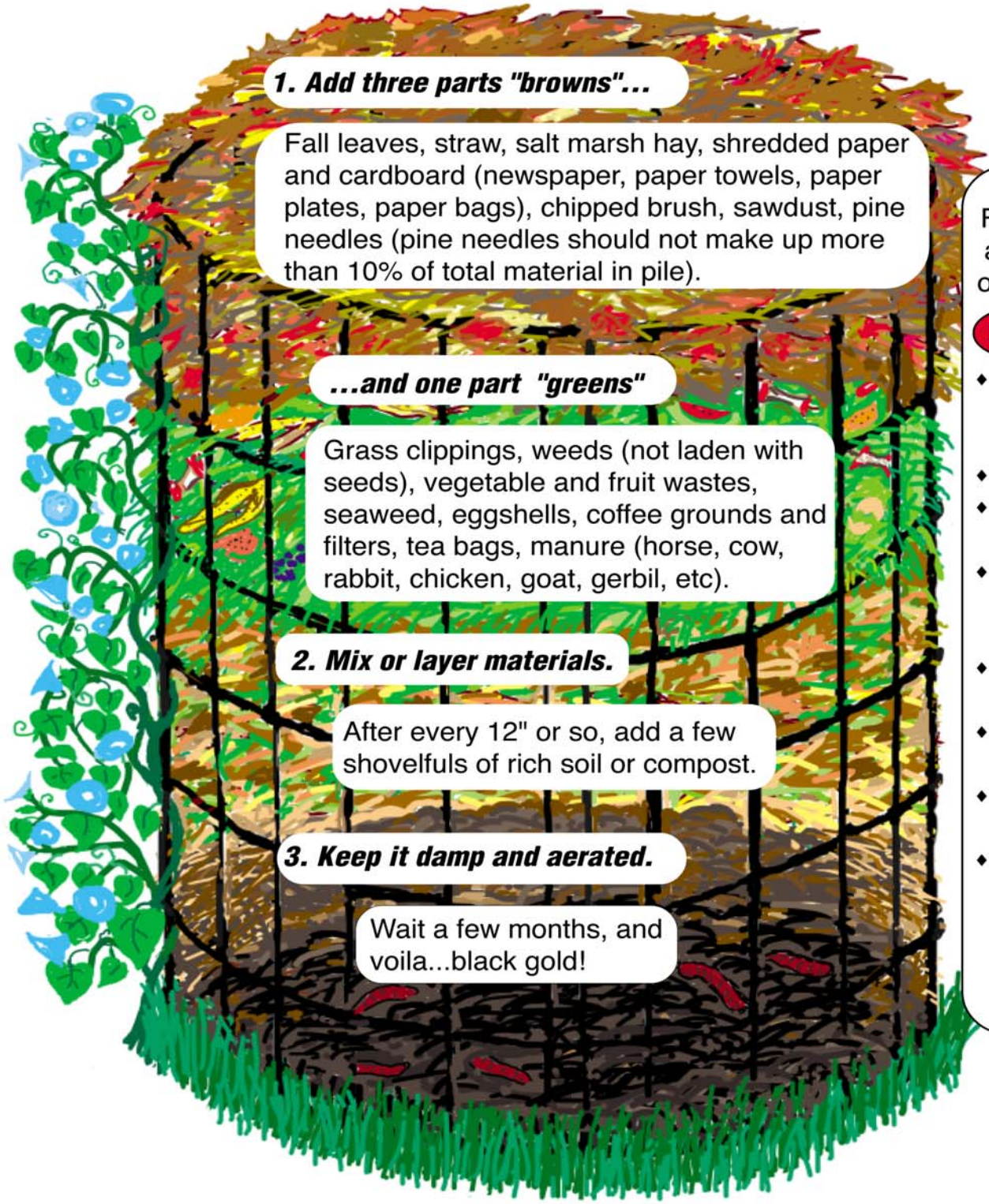
A homeowner's guide to healthy habits for clean water



EPA United States Environmental Protection Agency

Composting is easy!

To make compost, just follow these simple steps:



1. Add three parts "browns"...

Fall leaves, straw, salt marsh hay, shredded paper and cardboard (newspaper, paper towels, paper plates, paper bags), chipped brush, sawdust, pine needles (pine needles should not make up more than 10% of total material in pile).

...and one part "greens"

Grass clippings, weeds (not laden with seeds), vegetable and fruit wastes, seaweed, eggshells, coffee grounds and filters, tea bags, manure (horse, cow, rabbit, chicken, goat, gerbil, etc).

2. Mix or layer materials.

After every 12" or so, add a few shovelfuls of rich soil or compost.

3. Keep it damp and aerated.

Wait a few months, and voila...black gold!

For best results, and to keep out odors and pests,

DO NOT ADD:

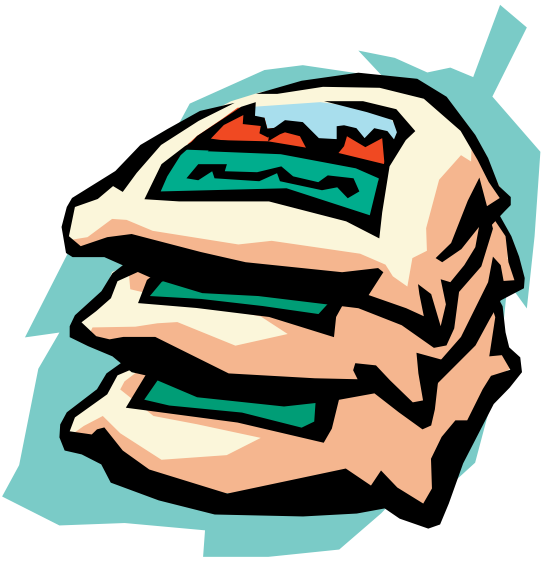
- Meat, bones, fat, grease, oils
- Peanut butter
- Dairy products
- Cooked foods with sauces or butter
- Dog and cat manure
- Diseased plants
- Weeds gone to seed
- Weeds that spread by roots and runners (vines)

Prepared by the Massachusetts Department of Environmental Protection

A MASSACHUSETTS BUREAU OF FARM PRODUCTS & PLANT INDUSTRIES FACT SHEET

Protecting Water Sources from Fertilizer

Fertilizers used to promote plant growth and lush green lawns also have the potential to contaminate water sources if applied improperly. The principle components of fertilizer are Nitrogen, Phosphorus and Potassium (N-P-K). **Nitrogen** is the main nutrient for new, green growth, **Phosphorus** promotes root development and **Potassium** improves the overall health of plants. Excessive amounts of nitrogen and phosphorus are the nutrients most likely to adversely affect water quality.



You can prevent ground and surface water contamination by observing the following practices when buying and applying fertilizers:

- **Test your soil.** Soil testing is the most critical step in any lawn fertility program by providing the information needed to select the fertilizer with the N-P-K value best suited to the nutritional needs of your soil. If you use a lawn care service insist they test your soil before any applications are made.

- **Use a slow-release nitrogen fertilizer.** There are two basic forms of nitrogen contained in fertilizer products: **fast-release** or Water Soluble Nitrogen (WSN), and **slow-release** or Water Insoluble Nitrogen (WIN). Slow-release fertilizers provide a more controlled release of nitrogen thereby limiting the amount of fertilizer leaching into groundwater. Also remember that **weed and feed** fertilizers contain pesticides which pose additional risks to water sources.

- **Use iron as a supplement to nitrogen.** Iron can be used alone or in combination with nitrogen to provide a greening response. Adding iron will decrease the amount of nitrogen needed thereby minimizing the amount of nitrate leaching into water sources.

- **Choose the proper spreader and calibrate it correctly.** By using a drop spreader instead of a rotary spreader near water supply sources and storm drains, you decrease the risk of fertilizer contamination. Proper calibration helps prevent misapplication of the fertilizer.

- **Time your fertilizer applications.** Fast-acting fertilizers should not be applied before a heavy rainfall. Spring fertilization should be minimized—water tables are generally high at that time, thereby increasing the risk of fertilizer leaching into water sources. Do not apply fertilizer on frozen ground—the likelihood of runoff into water supply sources is dramatically increased. Avoid fall nitrogen applications on coarse-textured soils. These soil types have low water holding capacities and a high potential of nitrate leaching.

- **Use buffer strips.** Leave a strip of unfertilized grasses or natural vegetation near any water body. This helps against erosion and produces a trap for unwanted nutrients.

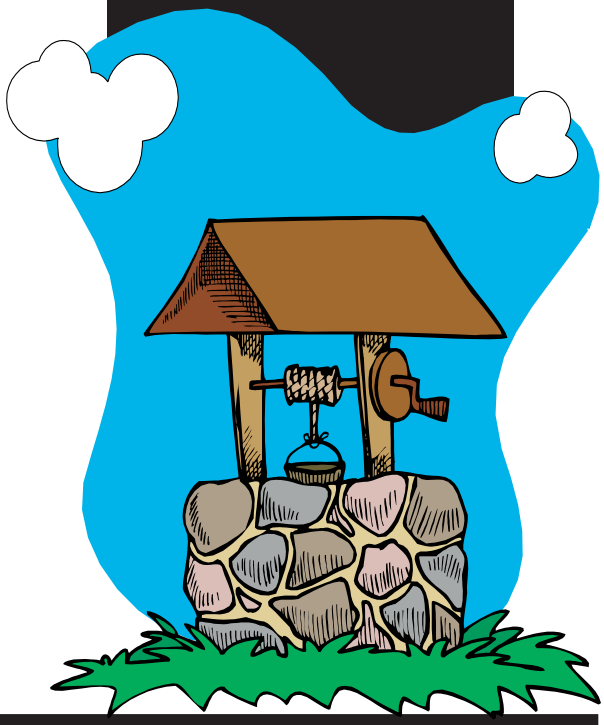
- **Minimize fertilizer rates on slopes.** The potential for runoff is decreased if you limit the amount of fertilizer in these locations.

- **Use a mulching mower.** Mulching the grass and leaving the clippings reduces the need for fertilizer by as much as one-half.

- **Prevent misapplication of fertilizers.** Take care when applying fertilizers around sewers and drains. Shut off spreaders before crossing sidewalks or driveways and sweep up any spills. Rinse your spreader over the lawn area and not on the driveway in order to minimize fertilizer runoff.

- **Properly store your fertilizer.** Unused fertilizer should be removed from the spreader and returned to the original bag or container for future use. Store unused fertilizer in a dry place away from any water source. If stored fertilizer gets wet you not only lose nutrient value, there is potential for nitrates to leach into water sources.

Fertilizers should not be applied within the Zone I protective radius of a public drinking water supply.



Any questions or concerns about fertilizer use should be directed to:

The Bureau of Farm Products and Plant Industries at the Massachusetts Department of Food and Agriculture (DFA), 251 Causeway Street, Boston, MA 02114. Telephone: 617- 626-1700. Website: www.massdfa.org

For information on protecting water sources from Pesticides refer to the Pesticide Fact Sheet

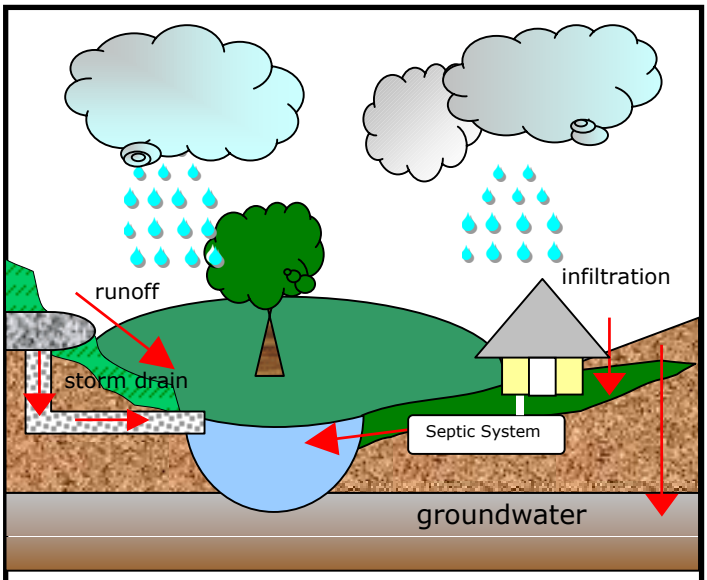
Massachusetts Department of ENVIRONMENTAL PROTECTION

GIVE YOUR LAKE THE BLUES!

Protecting Your Lake from Nonpoint Source Pollution

Lake Water Quality, Watersheds, and Nonpoint Source Pollution

A lake's water quality reflects what is happening in its surrounding watershed. A watershed includes all the land, or drainage area, that drains into a stream, lake or other waterbody. Nonpoint source (NPS) pollution occurs when water (i.e. stormwater, snowmelt, water from a garden hose) flows throughout the watershed, picking up pollutants and depositing them into water resources. Common types of NPS pollutants include phosphorus and nitrogen in lawn and garden fertilizers, pet waste, phosphorus and bacteria from septic systems, oil and grease from parking lots, and sediment from construction activities and soil erosion.



NPS pollution does not observe property lines. It flows wherever water takes it throughout the watershed – typically to stormdrains and then, without any treatment, into nearby streams and lakes.

How Does NPS Pollution Affect Lake Water Quality?

The combined effect of NPS pollutants such as phosphorus, sediment and bacteria result in degraded water quality and loss of recreational use and wildlife habitat. This accelerated degradation as a result of human activity in the watershed is called "cultural eutrophication".

- Excessive nutrients such as phosphorus stimulate algal and plant growth, limiting the recreational use of the lake (fishing, swimming and boating) and degrading wildlife habitat.
- Sediment can cause serious damage to the lake by causing turbidity and filling-in sensitive habitat that is needed for aquatic life. It also transports phosphorus.
- Bacteria from failing or substandard septic systems, pet waste, and waterfowl often cause swimming beach closures.

This information is available in alternative format by calling our ADA Coordinator at (617) 574-6872.
Produced by the Massachusetts Department of Environmental Protection, Division of Watershed Management, Nonpoint Source Program.
July 2001

Is There a Solution to NPS Pollution?

Cumulatively, watershed residents can have the greatest impact on the health of a lake. Steps to prevent or reduce NPS pollution can be simple and inexpensive. Preventing and reducing NPS pollution is the key to improving lake water quality. Every little bit helps!

Best Management Practices (BMPs) are activities that prevent nonpoint source pollution or mitigate the effects of NPS. It is easier and more cost effective to prevent pollution than to restore a degraded resource. BMPs can be structural, such as planting a buffer strip, or non-structural, such as analyzing lawn soils prior to applying fertilizer. Some simple and cost effective BMPs for residents include:

Encourage Infiltration and Control Sedimentation

- Minimize impervious surfaces such as driveways and parking lots to encourage infiltration.
- Slow or divert stormwater runoff toward vegetated areas where water can seep into the ground.
- Mulch and seed exposed soils to eliminate erosion.
- Wash cars over pervious surfaces, such as lawns, not over driveways, and wash undercarriages at a commercial car wash facility.

Reduce and Eliminate Nutrients and Bacteria

- Plant vegetation around driveways, shorelines and on slopes. The vegetation will absorb nutrients, filter out pollutants and trap sediment.
- Keep yard waste such as grass clippings and leaves out of the lake, storm drains, and off streets. Although yard waste is natural, when it decomposes it becomes high in nutrients.
- Reduce or eliminate fertilizer application, use organic, no-phosphate or slow-release fertilizer. To determine the phosphorus content in a fertilizer, look at the middle number in the formula on the package (i.e. Formula 16-**4**-8). Also, have your soil tested (Call the UMASS Extension Soil Testing Lab at (413) 545-2311 or download a soil test order form at http://www.umass.edu/plsoils/soiltest). You may not need to add fertilizer.
- Use phosphate free or low phosphate (less than 1%) automatic dishwashing detergents. Phosphate content in various dishwashing detergents sold in Massachusetts ranges from 0% up to 8.7% by weight. Gel detergents tend to have less phosphorus than powder detergents.
- Maintain septic tanks with regular pumping and inspection at least every 3-5 years.
- Pick up pet waste and dispose of it in the trash.
- Establish a vegetated buffer strip along shorelines to discourage waterfowl, such as geese, and avoid feeding them. The average goose will produce one pound of droppings a day!

For more information contact DEP's Regional Nonpoint Source Coordinators:

Northeast: Rosalia Barber
(978) 661-7816
rosalia.wollenhaupt@state.ma.us

Southeast: Jeff Brownell
(508) 946-2702
jeffrey.brownell@state.ma.us

Central: Brian Duval
(508) 849-4027
brian.duval@state.ma.us

Western: Tracey Miller
(413) 755-2162
tracey.miller@state.ma.us

Healthy Lawns – Healthy Water

Use Zero-Phosphorus Lawn Fertilizer!

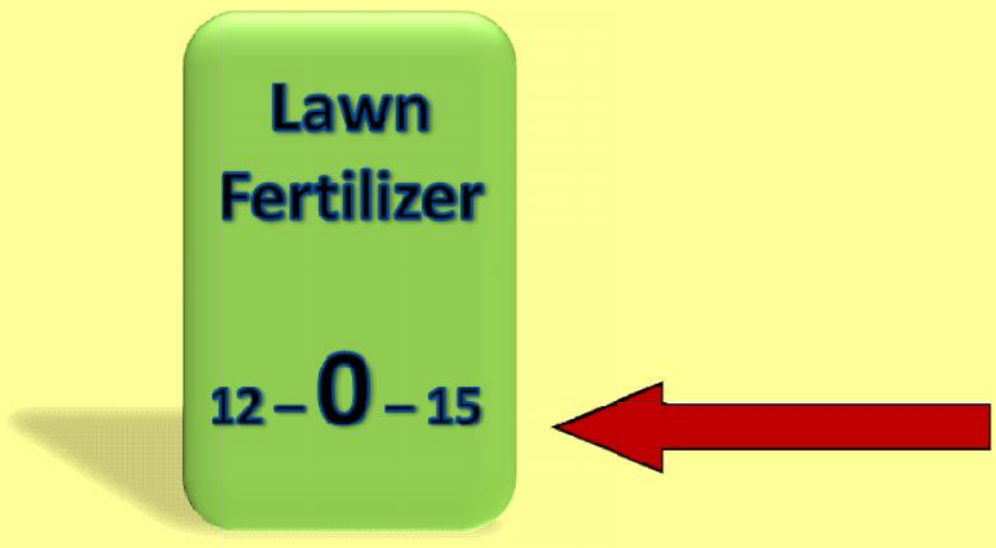
It's the Law!

Phosphorus runoff poses a threat to water quality. Therefore, under Massachusetts Law, phosphorus-containing fertilizer may only be applied to lawn or non-agricultural turf when:

- a soil test indicates that additional phosphorus is needed for the growth of that lawn or non-agricultural turf; or
- is used for newly established lawn or non-agricultural turf during the first growing season.

Most lawns in Massachusetts do not need additional phosphorus for healthy growth.

Look for the "Zero" to Protect Our Waters



Check the fertilizer bag for a set of three numbers representing the percentage of nitrogen (N), phosphorus (P) and potassium (K).

Buy the bag with a "0" in the middle: Zero Phosphorus!

Visit www.mass.gov/agr for more information and resources on plant nutrient management.

MDAR
MASSACHUSETTS DEPARTMENT OF AGRICULTURAL RESOURCES

Soil and Plant Nutrient Testing Laboratory
203 Paige Laboratory
161 Holdsworth Way
University of Massachusetts
Amherst, MA 01003
Phone: (413) 545-2311
e-mail: soiltest@umass.edu
website: http://soiltest.umass.edu/

USE THIS FORM FOR HOME GROUNDS AND GARDENS

Visit our website to download a copy of the Sampling Instructions sheet which includes a description of routine, and optional soil tests offered. Send your sample(s), completed submission form and payment to the address listed above. Enclose check payable to UMass for $15 for each sample plus additional fees for optional tests requested below.

Main contact:	**Send copy to:**	**Method of receiving results**
Name:	Name:	❑ US Mail (please include $2 for postage & handling)
Business Name:	Business Name:	
Street Address:	Street Address:	❑ E-mail
City, State, and Zip	City, State, and Zip	
Phone:	Phone:	
E-mail address:	E-mail address:	

LAB # (Leave blank)	**Sample ID** (You create this)	**Approx. area represented by sample** (sq ft. or acres)	**Crop Code, limit of 3** (See reverse side of this form)	**Routine analysis** ($15.00)	**Organic matter** ($6.00)	**Soluble salts** ($6.00)	**Nitrate** ($6.00)
				☑	❑	❑	❑
				☑	❑	❑	❑
				☑	❑	❑	❑
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Office Use Only	
Received	Due
Check#	PO#
Cash	

Order Total $ _____

Crop Codes

Lime and nutrient recommendations are provided on your test report specifically for the crop code(s) you identify on your soil sample submission form and are based on the analytical results for your sample. Crop Codes for home grounds and gardens are listed below. Select the crop code that best describes your management objectives.

Home Lawns

Description	Crop Code
Lawn-Establishment	HA1
Lawn-Maintenance	HA2

Home Gardens, Trees and Shrubs

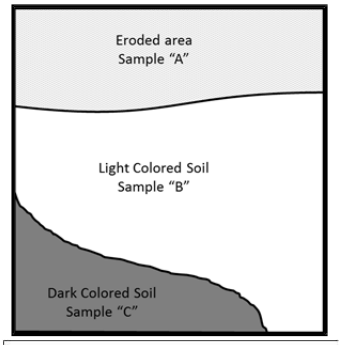
Description	Crop Code
Flowers, Roses, & Herbs	HB3E
Home Vegetable Garden (mixed)	HB1
Home Blueberries-Establishment	HD1E
Home Blueberries-Maintenance	HD1M
Home Brambles-Establishment	HD2E
Home Brambles-Maintenance	HD2M
Home Strawberries-Establishment	HD3E
Home Strawberries-Maintenance	HD3M
Home Grapes, American Varieties-Establishment	HD4E
Home Grapes, American Varieties-Maintenance	HD4M
Home Grapes, European Varieties-Establishment	HD5E
Home Grapes, European Varieties-Maintenance	HD5M
Deciduous Trees, Shrubs & Vines-Establishment	HC1E
Deciduous Trees, Shrubs & Vines-Maintenance	HC1M
Needleleaf Trees & Shrubs-Establishment	HC2E
Needleleaf Trees & Shrubs-Maintenance	HC2M
Acid-loving Trees, Shrubs, & Groundcover-Establishment	HC3E
Acid-loving Trees, Shrubs, & Groundcover –Maintenance	HC3M

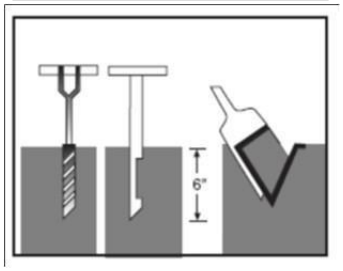
Soil and Plant Nutrient Testing Laboratory
203 Paige Laboratory
161 Holdsworth Way
University of Massachusetts
Amherst, MA 01003

Phone: (413) 545-2311
email: soiltest@umass.edu
website: http://soiltest.umass.edu/

Soil Sampling Instructions

The most critical step in soil testing is collecting the sample. It is important that you take the necessary steps to obtain a representative sample; a poor sample could result in erroneous recommendations.





The first step is to determine the area that will be represented by the sample. Soil physical appearance, texture, color, slope, drainage, and past management should be similar throughout the area. It may be helpful to draw a map of the property and identify areas where you will collect samples. Using a clean bucket and a spade, auger, or sampling tube collect 12 or more subsamples to a depth of six to eight inches (four to six inches for turf) from random spots within the defined area. Avoid sampling field or plot edges and other non-representative areas. Avoid sampling when the soil is very wet or within six to eight weeks after a lime or fertilizer application.

Next, break up any lumps or clods of soil, remove stones, roots, and debris, and thoroughly mix subsamples in the bucket. Once the sample is thoroughly mixed, scoop out approximately **one cup** of soil and spread on a clean sheet of paper to air-dry. A fan set on low will help speed the drying; do not apply heat. **Do not submit wet soil samples to the lab.**

Place approximately **one cup** of your dry sample in a plastic zip-lock bag. Label each zip-lock bag with your sample ID (you create this) and complete the submission form.

Complete all information on the sample submission form (found on our website). Provide your contact information, including a phone number and email address, under "Main contact." If you would like a copy of your results sent to anyone else, include their contact information under "Send copy to." Enter your Sample ID using the same name you labeled your samples with. Please include the approximate area represented by each sample. This information is useful to the lab and will be reported with your results. A rough approximation is adequate (i.e., +/- 1000 square feet for turf or +/- one acre for row crops).

Be sure to specify a Crop Code for each sample; without a Crop Code, the lab cannot provide lime and nutrient recommendations. Crop codes are listed on the second page of the submission forms. Finally select any optional tests you would like in addition to routine soil analysis. A brief description of these is proved below.

Send your sample(s), completed submission form and payment to the address listed on the front. Enclose check payable to UMass with your order. Please include $2 for postage and handling if you would like your results sent by US Mail.

Soil Test Descriptions & Fees

Routine Soil Analysis

Standard fertility test: $15.00

Includes pH, acidity, Modified Morgan extractable nutrients (P, K, Ca, Mg, Fe, Mn, Zn, Cu, B), lead, and aluminum, cation exchange capacity, and percent base saturation. Recommendations for nutrient and pH adjustment are included with results.

Optional Additional Soil Analysis

Soil organic matter: $ 6.00

Measurement of soil organic matter by loss on ignition at 360° C. This measure is useful for evaluating soil quality and nutrient supplying capacity. A measure of soil organic matter is also required to determine the effective rate for certain herbicides.

Soluble salts: $ 6.00

Measure of electrical conductivity of a 1:2 soil:water extract. This test is used to determine if salinity levels are high enough to limit plant growth. Sources of soluble salts in Northeastern soils include fertilizers, animal manure, compost, runoff from surfaces treated with de-icing salts, and poor quality irrigation water.

Soil nitrate: $ 6.00

Measurement of nitrate nitrogen (NO_3-N) using an ion specific electrode. Due to the inherent variability of soil NO3- N in our climate, these results are not directly used to make nutrient recommendations. However, under certain conditions this test may provide useful information for nutrient management.

EPA
United States
Environmental Protection
Agency

EPA 841-F-05-001

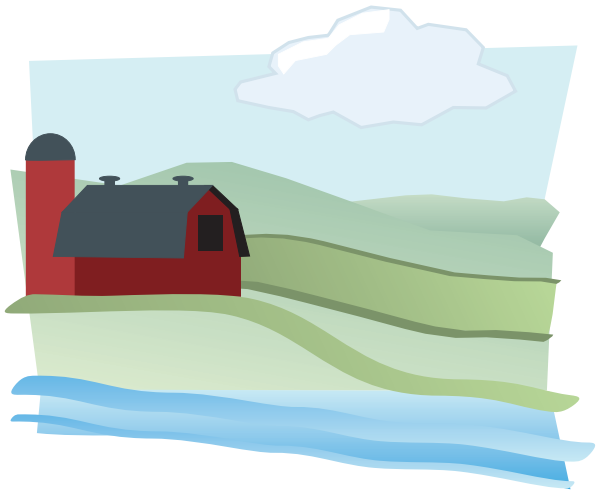
Protecting Water Quality *from* Agricultural Runoff

Clean Water Is Everybody's Business

The United States has more than 330 million acres of agricultural land that produce an abundant supply of food and other products. American agriculture is noted worldwide for its high productivity, quality, and efficiency in delivering goods to the consumer. When improperly managed however, activities from working farms and ranches can affect water quality.

In the 2000 *National Water Quality Inventory,* states reported that agricultural nonpoint source (NPS) pollution is the leading source of water quality impacts on surveyed rivers and lakes, the second largest source of impairments to wetlands, and a major contributor to contamination of surveyed estuaries and ground water. Agricultural activities that cause NPS pollution include poorly located or managed animal feeding operations; overgrazing; plowing too often or at the wrong time; and improper, excessive, or poorly timed application of pesticides, irrigation water, and fertilizer.

Pollutants that result from farming and ranching include sediment, nutrients, pathogens, pesticides, metals, and salts. Impacts from agricultural activities on surface water and ground water can be minimized by using management practices that are adapted to local conditions. Many practices designed to reduce pollution also increase productivity and save farmers and ranchers money in the long run.



What Is Nonpoint Source Pollution?

Nonpoint source (NPS) pollution, unlike pollution from point sources such as industrial and sewage treatment plants, comes from many diffuse sources. Polluted runoff is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into watersheds through lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water.

Did you know that runoff from farms is the leading source of impairments to surveyed rivers and lakes?

There are many government programs available to help farmers and ranchers design and pay for management approaches to prevent and control NPS pollution. For example, over 40 percent of section 319 Clean Water Act grants have been used to control NPS pollution from working farms and ranches. Also, many programs funded by the U.S. Department of Agriculture and by states provide cost-share, technical assistance, and economic incentives to implement NPS pollution management practices. Many local organizations and individuals have come together to help create regional support networks to adopt technologies and practices to eliminate or reduce water quality impacts caused by agricultural activities.

Sedimentation

The most prevalent source of agricultural water pollution is soil that is washed off fields. Rain water carries soil particles (sediment) and dumps them into nearby lakes or streams. Too much sediment can cloud the water, reducing the amount of sunlight that reaches aquatic plants. It can also clog the gills of fish or smother fish larvae. In addition, other pollutants like fertilizers, pesticides, and heavy metals are often attached to the soil particles and wash into the water bodies, causing algal blooms and depleted oxygen, which is deadly to most aquatic life. Farmers and ranchers can reduce erosion and sedimentation by 20 to 90 percent by applying management practices that control the volume and flow rate of runoff water, keep the soil in place, and reduce soil transport.

Nutrients

Farmers apply nutrients such as phosphorus, nitrogen, and potassium in the form of chemical fertilizers, manure, and sludge. They may also grow legumes and leave crop residues to enhance production. When these sources exceed plant needs, or are applied just before it rains, nutrients can wash into aquatic ecosystems. There they can cause algae blooms, which can ruin swimming and boating opportunities, create foul taste and odor in drinking water, and kill fish by removing oxygen from the water. High concentrations of nitrate in drinking water can cause methemoglobinemia, a potentially fatal disease in infants, also known as blue baby syndrome. To combat nutrient losses, farmers can implement nutrient management plans that help maintain high yields and save money on fertilizers.

Animal Feeding Operations

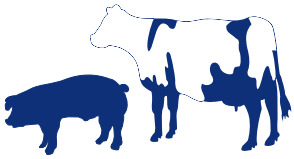
By confining animals in small areas or lots, farmers and ranchers can efficiently feed and maintain livestock. But these confined areas become major sources of animal waste. An estimated 238,000 working farms and ranches in the United States are considered animal feeding operations, generating about 500 million tons of manure each year. Runoff from poorly managed facilities can carry pathogens such as bacteria and viruses, nutrients, and oxygen-demanding organics and solids that contaminate shellfishing areas and cause other water quality problems. Ground water can also be contaminated by waste seepage. Farmers and ranchers can limit discharges by storing and managing facility wastewater and runoff with appropriate waste management systems.

Livestock Grazing

Overgrazing exposes soils, increases erosion, encourages invasion by undesirable plants, destroys fish habitat, and may destroy streambanks and floodplain vegetation necessary for habitat and water quality filtration. To reduce the impacts of grazing on water quality, farmers and ranchers can adjust grazing intensity, keep livestock out of sensitive areas, provide alternative sources of water and shade, and promote revegetation of ranges, pastures, and riparian zones.

Irrigation

Irrigation water is applied to supplement natural precipitation or to protect crops against freezing or wilting. Inefficient irrigation can cause water quality problems. In arid areas, for example, where rainwater does not carry minerals deep into the soil, evaporation of irrigation water can concentrate salts. Excessive irrigation can affect water quality by causing erosion, transporting nutrients, pesticides, and heavy metals, or decreasing the amount of water that flows naturally in streams and rivers. It can also cause a buildup of selenium, a toxic metal that can harm waterfowl reproduction. Farmers can reduce NPS pollution from irrigation by improving water use efficiency. They can measure actual crop needs and apply only the amount of water required. Farmers may also choose to convert irrigation systems to higher efficiency equipment.



Pesticides

Insecticides, herbicides, and fungicides are used to kill agricultural pests. These chemicals can enter and contaminate water through direct application, runoff, and atmospheric deposition. They can poison fish and wildlife, contaminate food sources, and destroy the habitat that animals use for protective cover. To reduce contamination from pesticides, farmers should use Integrated Pest Management (IPM) techniques based on the specific soils, climate, pest history, and crop conditions for a particular field. IPM encourages natural barriers and limits pesticide use and manages necessary applications to minimize pesticide movement from the field.

Farm Bill Conservation Funding

In May 2002 President Bush signed the Farm Bill, providing up to $13 billion for conservation programs for six years. This Farm Bill represents an 80 percent increase above current levels of funding available for conservation programs designed to prevent polluted runoff. For more information, visit www.usda.gov/farmbill.

Related Publications and Web Sites

National Management Measures to Control Nonpoint Source Pollution from Agriculture

epa.gov/nps/agmm

This technical guidance and reference document is for use by state, local, and tribal managers in the implementation of nonpoint source pollution management programs. It contains information on effective, readily available, and economically achievable means of reducing pollution of surface and ground water from agriculture.

Agricultural Nonpoint Source Pollution Management Web Site

epa.gov/nps/agriculture.html

This web site features a collection of links to helpful documents, federal programs, partnerships and nongovernmental orrganizations that convey advice and assistance to farmers and ranchers for protecting water quality.

National Agriculture Compliance Assistance Center

epa.gov/agriculture or call toll-free: 1-888-663-2155

EPA's National Agriculture Compliance Assistance Center is the "first stop" for information about environmental requirements that affect the agricultural community.

Animal Feeding Operations (AFO) Web Sites

AFO Virtual Information Center: epa.gov/npdes/afovirtualcenter
Overview of regulations and helpful links: epa.gov/npdes/afo

Funding Sources

Searchable Catalog of Federal Funding Sources for Watershed Protection

epa.gov/watershedfunding

Agricultural Management Assistance Database

www.nrcs.usda.gov/programs/ama

Clean Water Act Section 319(h) funding (epa.gov/nps/319hfunds.html) is provided to designated state and tribal agencies to implement approved nonpoint source management programs.

Environmental Quality Incentives Program (www.nrcs.usda.gov/programs/eqip) offers financial, technical, and educational assistance to install or implement structural, vegetative, and management practices designed to conserve soil and other natural resources.

Conservation Reserve and Conservation Reserve Enhancement Programs (www.fsa.usda.gov/dafp/cepd/default.htm) implemented by the U.S. Department of Agriculture provide financial incentives to encourage farmers and ranchers to voluntarily protect soil, water, and wildlife resources.

For More Information

U.S. Environmental Protection Agency
Nonpoint Source Control Branch (4503T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

epa.gov/nps

Revised
March 2005

EPA
United States
Environmental Protection
Agency

EPA 841-F-03-003

Protecting Water Quality *from* URBAN RUNOFF

Clean Water Is Everybody's Business

In urban and suburban areas, much of the land surface is covered by buildings and pavement, which do not allow rain and snowmelt to soak into the ground. Instead, most developed areas rely on storm drains to carry large amounts of runoff from roofs and paved areas to nearby waterways. The stormwater runoff carries pollutants such as oil, dirt, chemicals, and lawn fertilizers directly to streams and rivers, where they seriously harm water quality. To protect surface water quality and groundwater resources, development should be designed and built to minimize increases in runoff.

The most recent National Water Quality Inventory reports that runoff from urbanized areas is the leading source of water quality impairments to surveyed estuaries and the third-largest source of impairments to surveyed lakes.

Did you know that because of impervious surfaces like pavement and rooftops, a typical city block generates more than 5 times more runoff than a woodland area of the same size?

How Urbanized Areas Affect Water Quality

Increased Runoff

The porous and varied terrain of natural landscapes like forests, wetlands, and grasslands traps rainwater and snowmelt and allows them to filter slowly into the ground. In contrast, impervious (nonporous) surfaces like roads, parking lots, and rooftops prevent rain and snowmelt from infiltrating, or soaking, into the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly in unnaturally large amounts.

Storm sewer systems concentrate runoff into smooth, straight conduits. This runoff gathers speed and erosional power as it travels underground. When this runoff leaves the storm drains and empties into a stream, its excessive volume and power blast out streambanks, damaging streamside vegetation and wiping out aquatic habitat. These increased storm flows carry sediment loads from construction sites and other denuded surfaces and eroded streambanks. They often carry higher water temperatures from streets, roof tops, and parking lots, which are harmful to the health and reproduction of aquatic life.

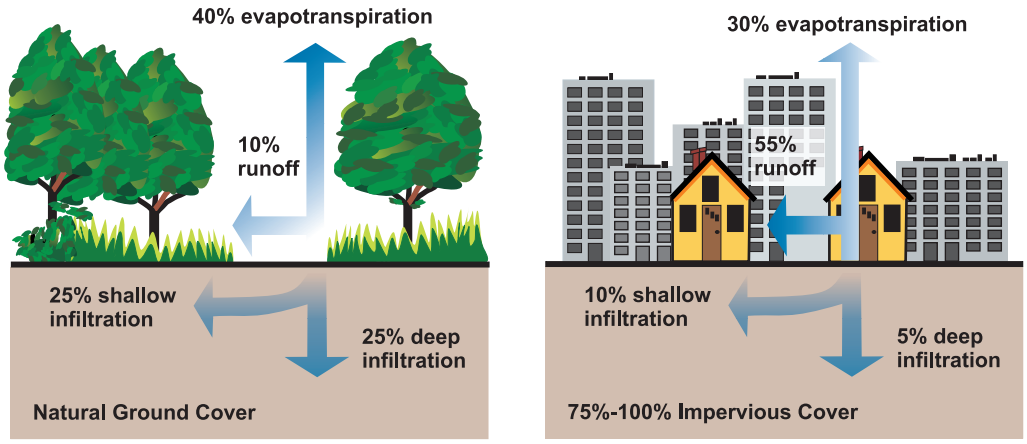
The loss of infiltration from urbanization may also cause profound groundwater changes. Although urbanization leads to great increases in flooding during and immediately after wet weather, in many instances it results in lower stream flows during dry weather. Many native fish and other aquatic life cannot survive when these conditions prevail.

Increased Pollutant Loads

Urbanization increases the variety and amount of pollutants carried into streams, rivers, and lakes. The pollutants include:

- Sediment
- Oil, grease, and toxic chemicals from motor vehicles
- Pesticides and nutrients from lawns and gardens
- Viruses, bacteria, and nutrients from pet waste and failing septic systems
- Road salts
- Heavy metals from roof shingles, motor vehicles, and other sources
- Thermal pollution from dark impervious surfaces such as streets and rooftops

These pollutants can harm fish and wildlife populations, kill native vegetation, foul drinking water supplies, and make recreational areas unsafe and unpleasant.



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

Managing Urban Runoff

What Homeowners Can Do

To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns. Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose. Instead of disposing of yard waste, they can use the materials to start a compost pile. And homeowners can learn to use Integrated Pest Management (IPM) to reduce dependence on harmful pesticides.

In addition, households can prevent polluted runoff by picking up after pets and using, storing, and disposing of chemicals properly. Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed. Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that do not generate runoff. Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.

Controlling Impacts from New Development

Developers and city planners should attempt to control the volume of runoff from new development by using low impact development, structural controls, and pollution prevention strategies. Low impact development includes measures that conserve natural areas (particularly sensitive hydrologic areas like riparian buffers and infiltrable soils); reduce development impacts; and reduce site runoff rates by maximizing surface roughness, infiltration opportunities, and flow paths.

Controlling Impacts from Existing Development

Controlling runoff from existing urban areas is often more costly than controlling runoff from new developments. Economic efficiencies are often realized through approaches that target "hot spots" of runoff pollution or have multiple benefits, such as high-efficiency street sweeping (which addresses aesthetics, road safety, and water quality). Urban planners and others responsible for managing urban and suburban areas can first identify and implement pollution prevention strategies and examine source control opportunities. They should seek out priority pollutant reduction opportunities, then protect natural areas that help control runoff, and finally begin ecological restoration and retrofit activities to clean up degraded water bodies. Local governments are encouraged to take lead roles in public education efforts through public signage, storm drain marking, pollution prevention outreach campaigns, and partnerships with citizen groups and businesses. Citizens can help prioritize the clean-up strategies, volunteer to become involved in restoration efforts, and mark storm drains with approved "don't dump" messages.

Related Publications

Turn Your Home into a Stormwater Pollution Solution!

www.epa.gov/nps

This web site links to an EPA homeowner's guide to healthy habits for clean water that provides tips for better vehicle and garage care, lawn and garden techniques, home improvement, pet care, and more.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas

www.epa.gov/owow/nps/urbanmm

This technical guidance and reference document is useful to local, state, and tribal managers in implementing management programs for polluted runoff. Contains information on the best available, economically achievable means of reducing pollution of surface waters and groundwater from urban areas.

Onsite Wastewater Treatment System Resources

www.epa.gov/owm/onsite

This web site contains the latest brochures and other resources from EPA for managing onsite wastewater treatment systems (OWTS) such as conventional septic systems and alternative decentralized systems. These resources provide basic information to help individual homeowners, as well as detailed, up-to-date technical guidance of interest to local and state health departments.

Low Impact Development Center

www.lowimpactdevelopment.org

This center provides information on protecting the environment and water resources through integrated site design techniques that are intended to replicate preexisting hydrologic site conditions.

Stormwater Manager's Resource Center (SMRC)

www.stormwatercenter.net

Created and maintained by the Center for Watershed Protection, this resource center is designed specifically for stormwater practitioners, local government officials, and others that need technical assistance on stormwater management issues.

Strategies: Community Responses to Runoff Pollution

www.nrdc.org/water/pollution/storm/stoinx.asp

The Natural Resources Defense Council developed this interactive web document to explore some of the most effective strategies that communities are using around the nation to control urban runoff pollution. The document is also available in print form and as an interactive CD-ROM.

For More Information

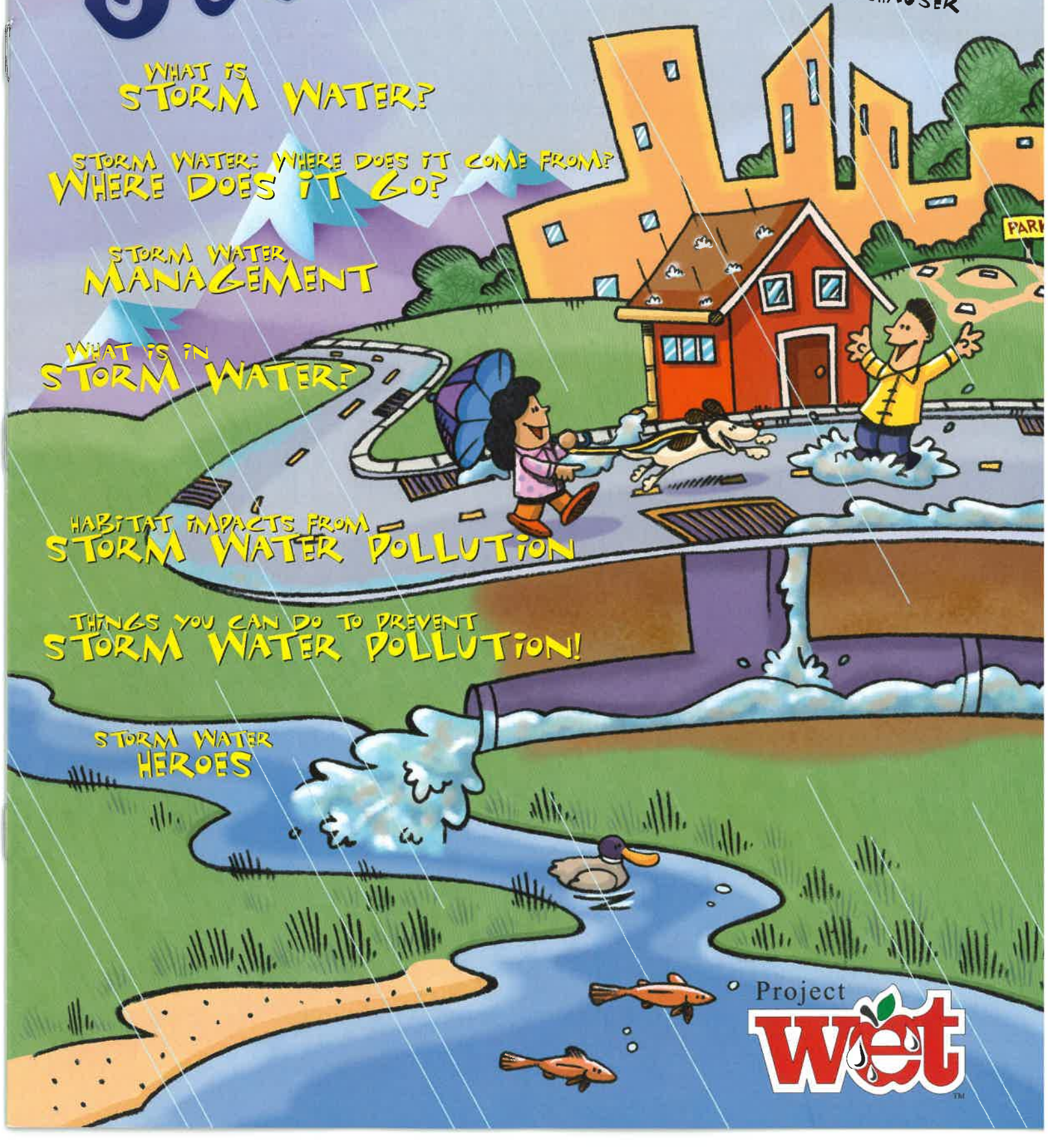
U.S. Environmental Protection Agency
Nonpoint Source Control Branch (4503T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

www.epa.gov/nps

February 2003

Discover Storm Water

Illustrations By Peter Grosshauser



What is Storm Water?

Storm Water: Where Does it Come From? Where Does it Go?

Storm Water Management

What is in Storm Water?

Habitat Impacts from Storm Water Pollution

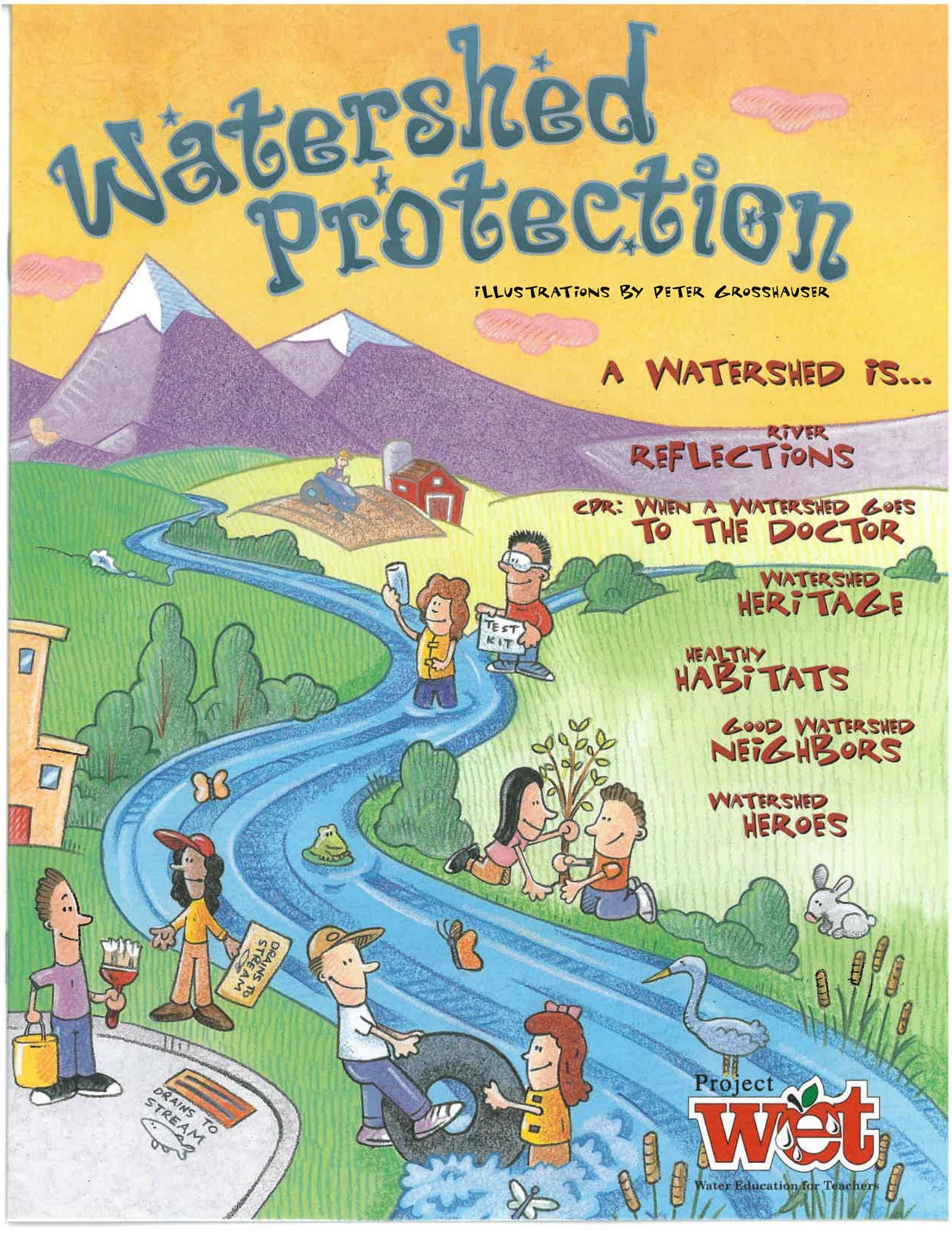
Things You Can Do To Prevent Storm Water Pollution!

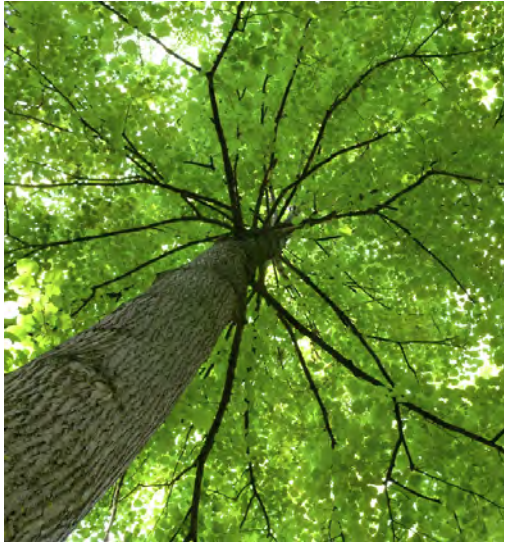
Storm Water Heroes

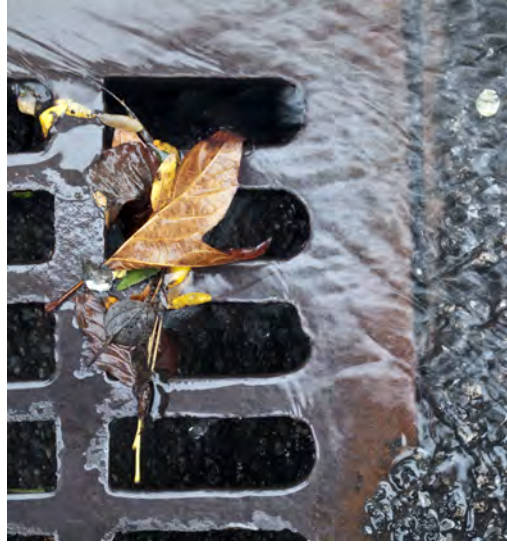
Project WET

Watershed protection

ILLUSTRATIONS BY PETER GROSSHAUSER







LAKE GARDNER & POWOW RIVER WATERSHED IMPROVEMENTS

In 2017, the Amesbury Department of Public Works completed a multi-year grant project to implement water quality improvements to Lake Gardner and the Powow River, both located within the Merrimack River Watershed. By making structural improvements to reduce stormwater impacts and providing outreach and educational support, this project will help reduce sediment, bacteria and nutrients entering our waterways.

Project elements include:

- Improvements to stormwater structures along Whitehall Road, Cynthia Road and Orchard Court to better manage and treat stormwater runoff.
- Updated displays containing nonpoint source pollution and watershed protection educational materials at the Department of Public Works that are free to residents and visitors.
- Installation of pet waste bag dispenser stations throughout the watershed.
- Participation in townwide Greenscapes Program.

For more information please contact the City of Amesbury Lakes & Waterways Commission or the Lake Gardner Improvement Association at www.lgia.org

This project has been financed with Federal Funds from the Environmental Protection Agency (EPA) to the Massachusetts Department of Environmental Protection (the Department) under an s. 319 competitive grant. The contents do not necessarily reflect the views and policies of EPA or of the Department, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

HOMEOWNER TIPS TO PROTECT YOUR WATERSHED

A HEALTHY WATERSHED STARTS AT HOME...
TIPS ON HOW YOU CAN REDUCE STORMWATER POLLUTION AND IMPROVE WATER QUALITY

Reduce or eliminate fertilizer use on your lawn and/or use an organic or slow release variety. Grass fertilizer can enter water bodies through storm drains and add harmful levels of nutrients.

Or better yet - complete a soil test every spring. You may not need any fertilizer!

Pick up after your dog and other pets. Pet waste contains potentially harmful bacteria that could pose a health risk. Bag it and put it in the trash or flush it down the toilet.

Don't dispose of lawn and garden waste near water. Excess grass clippings and leaves can use up vital oxygen in the water, which can lead to fish kills.

Maintain your septic system by inspecting your tank yearly. It is recommended that your septic tank be pumped out at least every 2-3 years. Septic system failures are a health hazard and a threat to groundwater.

Help reduce polluted runoff by storing all household chemicals and cleaners in covered, dry, and secure storage areas.

Pick-up trash and never throw anything into a catch basin, especially trash, oil or pet waste. Keep nearby storm grates trash free. Remember that most storm drains and catch basins lead directly to our lakes and streams.

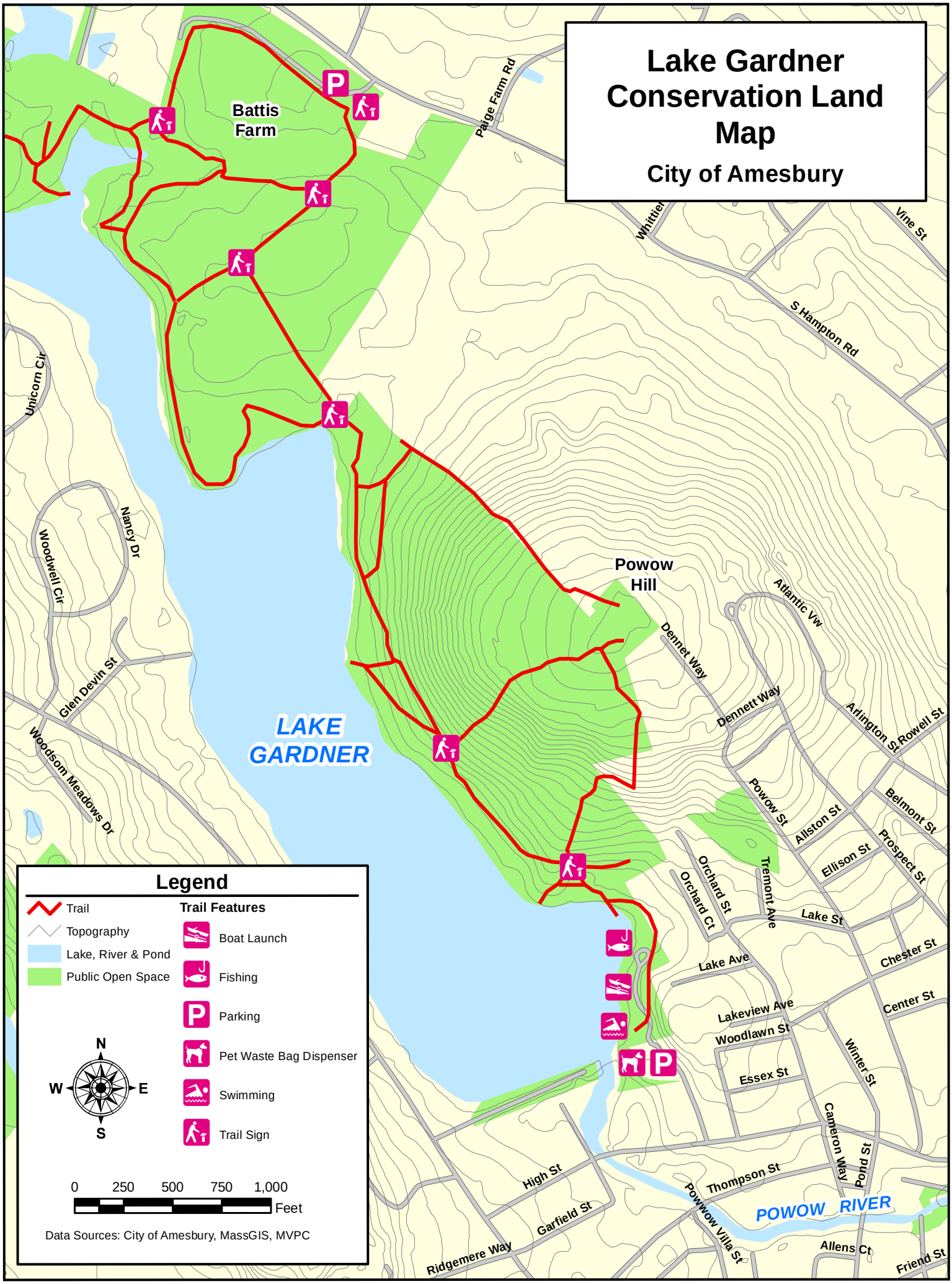
Sweep driveways and sidewalks to help reduce sand and salt that can be carried into storm drains by stormwater runoff.

Reduce or eliminate pesticide use around your home.

Bring your car to a commercial car wash where most facilities recycle water, or wash your car on the grass so wash water, dirt, and grease don't reach storm drains.

Maintain your vehicle by fixing leaks and disposing of used oil properly. Never pour oil or other engine fluids down a storm drain or catch basin.

Always clean your boat, trailer, and gear of plants before leaving the area. Invasive aquatic plants can easily be transported from one waterbody to another, decreasing water quality.


Lake Gardner Conservation Land Map
City of Amesbury
Battis Farm
Paige Farm Rd
Whittier
Vine St
S Hampton Rd
Unicorn Cir
Nancy Dr
Woodwell Cir
Glen Devin St
Woodsom Meadows Dr
LAKE GARDNER
Powow Hill
Dennett Way
Atlantic Vw
Arlington St
Rowell St
Powow St
Allston St
Belmont St
Ellison St
Prospect St
Orchard St
Orchard Ct
Tremont Ave
Lake St
Lake Ave
Chester St
Lakeview Ave
Woodlawn St
Center St
Essex St
Winter St
Cameron Way
Pond St
Thompson St
High St
Garfield St
Ridgemere Way
Powwow Villa St
POWOW RIVER
Allens Ct
Friend St
Legend
Trail
Topography
Lake, River & Pond
Public Open Space
Trail Features
Boat Launch
Fishing
Parking
Pet Waste Bag Dispenser
Swimming
Trail Sign
N
W
E
S
0 250 500 750 1,000
Feet
Data Sources: City of Amesbury, MassGIS, MVPC

Task 6 Deliverables

(see Final Report)

Task 7 Deliverables

AGENDA

Lake Gardner & Powow River Nonpoint Source Improvement Project

Start-Up Meeting – Project #14-05/319

Thursday, July 9, 2014

Grant Overview

Reporting

- Quarterly Reporting Package (due Oct, Jan, April, July)
    - Status Report
    - Payment Voucher/Invoices
    - MBE/WBE Form
    - Match Form – hours tracking
- End of Fiscal Year Deadline
- Final Report in DEP format due several months prior to end of contract

Payment

- Quarterly Payment Vouchers – or sooner
- Direct deposit within 30 days of receipt
- 10% retainage

Tasks

1. Quality Assurance & Project Evaluation
2. Design & Construct Stormwater Management BMPs
3. BMP O&M Plan
4. Pet Waste Management
5. Public Education & Outreach
6. Greenscapes 2014 & 2015
7. Reporting/PM

Schedule